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Power Plant ENGINEERING

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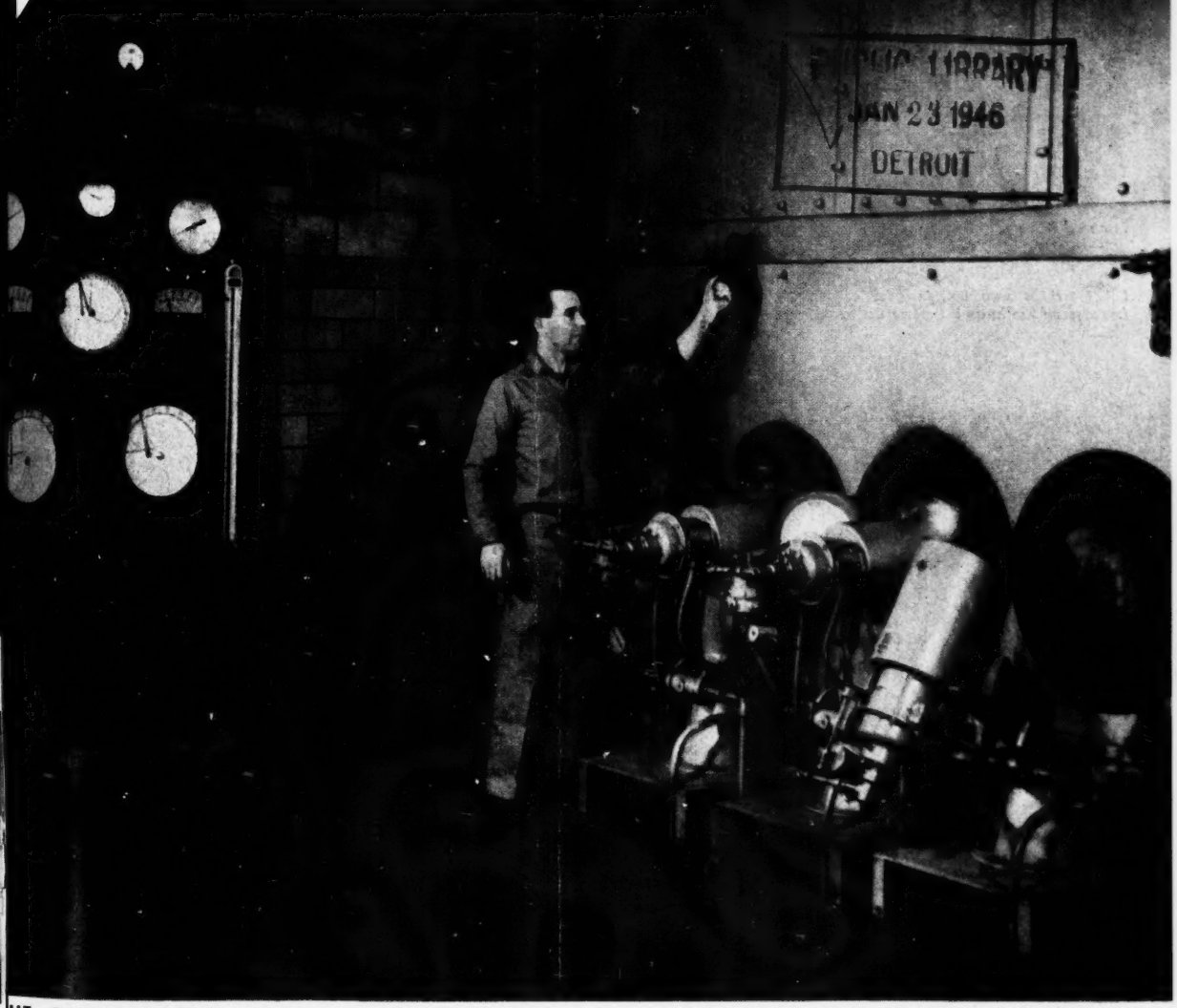


THE POWER ENGINEERING AND MAINTENANCE MAGAZINE FOR EVERY INDUSTRY

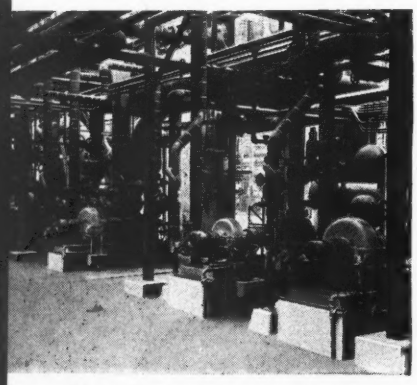
DECEMBER • 1945

Features

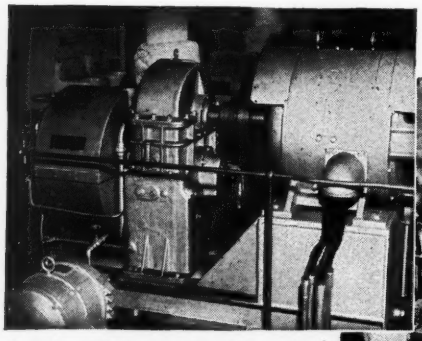
STEAM AND BLAST-FURNACE AIR FOR FONTANA • THE COAL ATOMIZER • CARE AND UPKEEP OF HEAT INSULATION • THE DEVELOPMENT OF ATOMIC ENERGY • FLUORESCENT LAMPS AND LIGHTING • YEARLY INDEX, PAGES 225-230 • CONTENTS PAGE 5

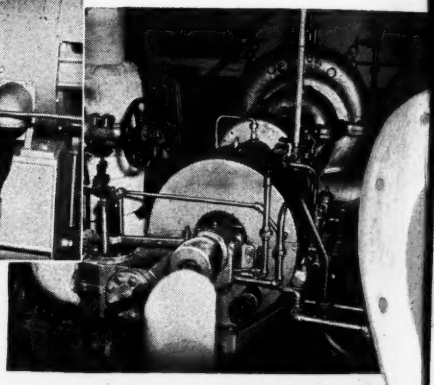
Reliable drives - indoors

ELLIOTT *Mechanical Drive* TURBINES



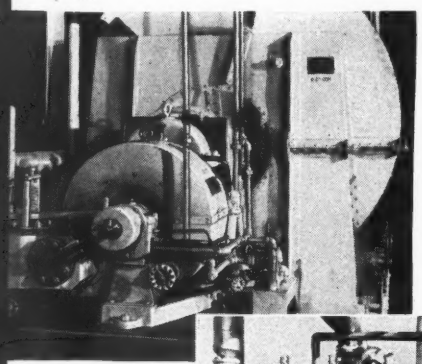
Typical line of Elliott turbines driving pumps in an oil refinery.

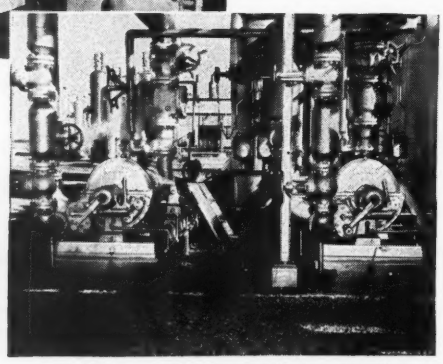




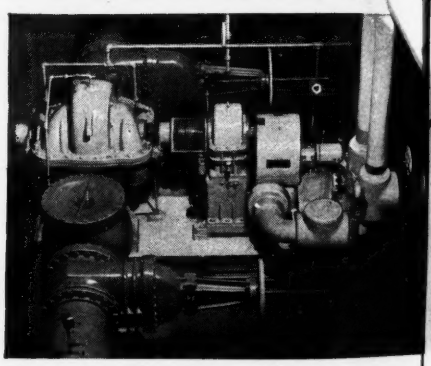
Seagoing Elliott geared turbine units—one driving a generator, the other a centrifugal ballast pump.

Elliott turbine with built-in gear driving a forced-draft fan in an important war materials plant.





Another out-of-doors installation, two of many Elliott turbines driving pumps in a large gasoline cycling plant.



Elliott turbine with built-in gear driving circulating water pump in a recently built steel mill power plant.

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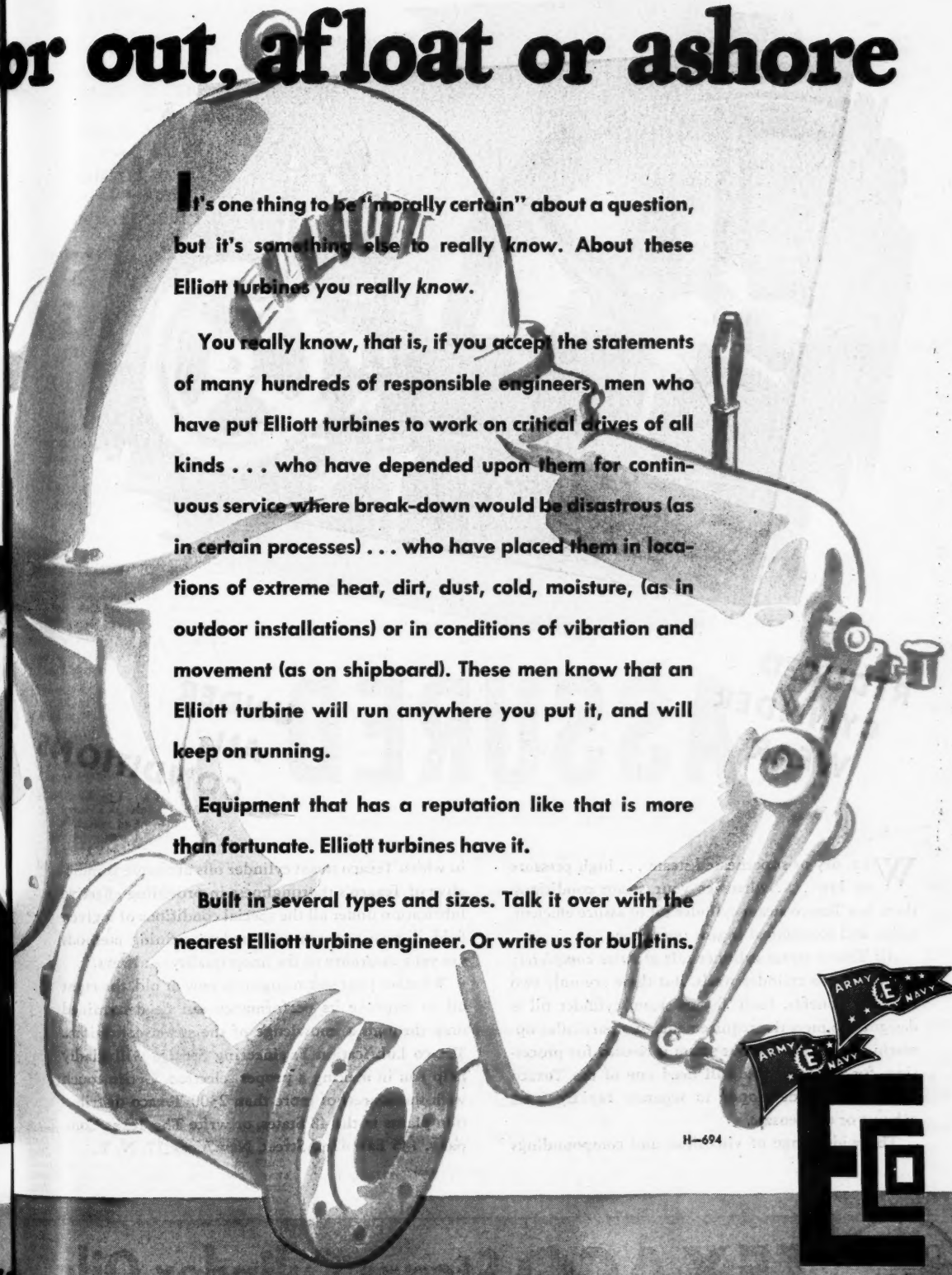

It's one thing to be "morally certain" about a question, but it's something else to really *know*. About these Elliott turbines you really *know*.

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Power Plant ENGINEERING

December 1945

VOLUME 49—NUMBER 12

Cover: One of the two 300 hp oil-fired boilers furnishing heat and process steam at Chicago plant of Kraft Foods Company.

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Contents of back issues of Power Plant Engineering will be found in Industrial Arts Index on file in Public Libraries.

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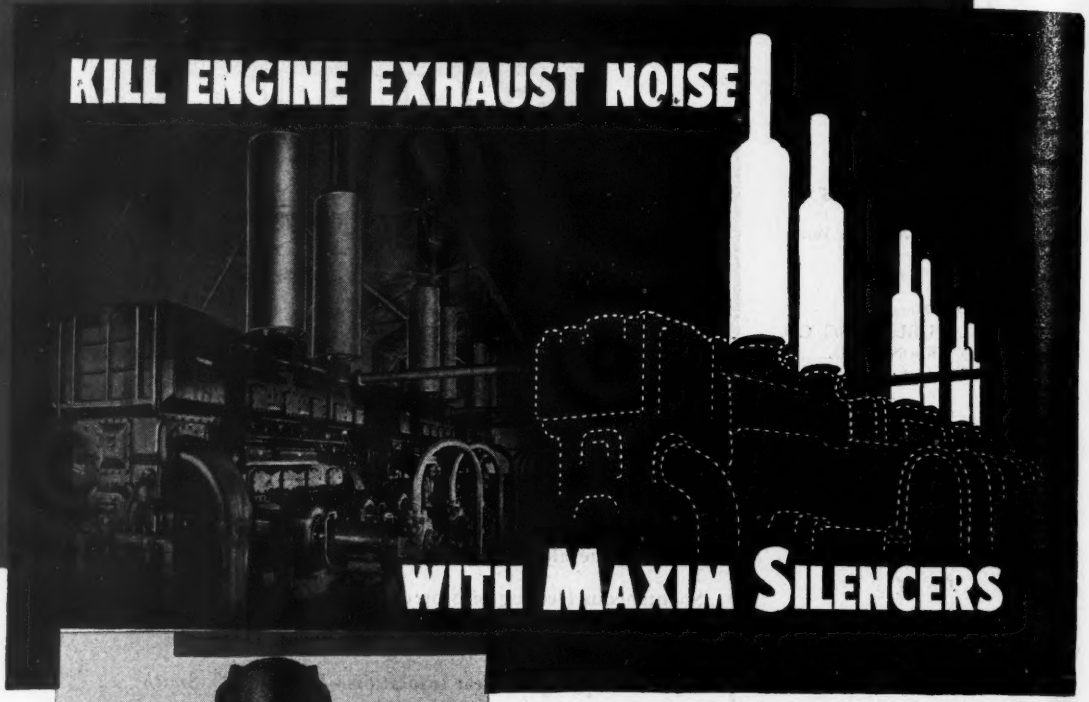

Maxim Exhaust & Intake Silencers silence the exhaust or intake of internal combustion engines, steam engine exhaust, compressor intake, vacuum pump discharge and the intake or discharge of blowers of the positive pressure type. Spark arresting included where necessary.

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Maxim engineers will be glad to recommend the correct silencing equipment to best meet your particular problem. Send your specifications to the address given below.

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WRITE FOR BULLETINS describing exhaust & intake silencers D 125, D 127, D 101, D 37.

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Front Lines

HOW THE AIRCRAFT CARRIER U. S. S. Franklin sat dead in the water for ten hours less than 60 miles off the coast of Japan, with four of her boilers damaged and no power to generate steam or electricity, is told by Lt. Comdr. Thomas J. Greene, Chief Engineer on the vessel in a recent issue of the Power Specialist. Commander Greene gave a great deal of credit for the ship's getting under way again to her superior boilers and their accessory equipment.

REPORT OF THE Human Engineering Laboratory and Johnson O'Connor Research Foundation for the years 1940 to 1945 has just been issued. The various branches of the laboratory tested 15,148 people in 1944 as compared with 7453 in 1943 and 4339 in 1940. The report gives data on the aims of the laboratory and foundation, lists of its published books and technical reports, and there are some interesting data on the studies of inheritance of aptitude. One interesting remark in the report is that attempts have been made to free creative imagination from the effects of writing speed. One test designed for this purpose failed to measure creative imagination but is probably a measure of a new element. Experiments now being carried on with a second test may succeed where the first one failed. Here is a point that needs investigation, for who knows how many important ideas have been lost for lack of a pencil or how a given idea is changed during the very process of writing it down.

THOSE WHO ARE interested in industrial developments in Mexico will do well to secure a copy of a recent address by Eduardo Villasenor, Director General of the Banco De Mexico, S. A., at the Eleventh Convention of the Mexican Bankers Association. A good translation of this address has just been made available by Armour Research Foundation, 3300 Federal Street, Chicago, Illinois. The Foundation has been conducting surveys of industry and science in Mexico.

A FLUORESCENT LAMP producing ultra-violet rays under which the dial markings of instruments are caused to glow, is a recent Westinghouse Lamp Division development. It was made originally for use on airplane instrument panels, also for illuminating military maps drawn with fluorescent ink to make them readable in the dark. There might be a few places around power plant instrument panels and other places in the plant where this type of illumination might prove very helpful, especially in an emergency.

THE STEEL INDUSTRY requires approximately 55,500 additional men to meet anticipated peace time production schedules according to a recent survey by the American Iron & Steel Institute.

A NEW BOOK The German Talks Back, by Heinrich Hauser, says many things that will make Americans very angry. But there is much in it that merits careful attention. However, says John Chamberlain, in the October issue of Harper's, he can't follow Hauser in his impressions of America. "He repeats," says Chamberlain, "The old charges that the United States is becoming Fordized and standardized, that its city proletariat must plunge the nation into turmoil and dictatorship, that we are forgetting the wisdom of Thomas Jefferson. Well, if there is one thing that this war has demonstrated, it is that Americans are not robots. And the next decade or so should see an end to city congestion and proletarianization in the United States. The road to decentralization is clearly marked in our new power appliances, our new means of locomotion. Moreover, it is footless to repeat in 1945 the old charge that we have wasted our soil and irretrievably spoiled our heritage. The battle for conservation is being won in America right now, as any traveler with a pair of eyes in his head must realize as he goes about the land."

A NEW ELECTRODE has been developed for arc welding copper. Previously the only satisfactory methods of fabricating copper have been oxyacetylene and carbon arc welding, brazing and soldering. Now a coated electrode known as EutecTrode 30 has been developed which will bring the metallic arc welding of copper within the reach of every arcwelder, using either a-c or d-c.

IN REGARD TO the charges of lack of culture of engineers and scientists, Herbert Fisher Moore, in the Illinois Alumni News of March, 1931, has said, "Why should we call uncultured the man who knows thoroughly and broadly the history and philosophy of the heat engine, but is ignorant of the music of Brahms, while we hail as cultured the musician who is a master of technique and knows the field of harmony but is contemptuous of the applied science which has made possible the modern pipe organ?

"The jack of all trades and master of none is not an admirable figure. The speaker believes that the jack of all trades and the master of one is an admirable figure, and is more deserving of the title of cultured man than is the super-master of one trade who despises all others"—David L. Arm, The Journal of Engineering Education, October, 1945.

THE FIRST LARGE scale plant for the manufacture of synthetic caffeine is to be built by Monsanto Chemical Co. in St. Louis. This plant will utilize an improved process whereby the synthetic material is derived from nitrogen of the air and hydrogen from water, simulating the natural process.

DEVELOPMENT and emergence of automatic processing control in its present status as an exact science is explained simply and instructively in a new book, The Principles of Industrial Process Control, by Donald P. Eckman, engineer of Brown Instrument Co., industrial division of Minneapolis-Honeywell Regulator Co., published by John Wiley & Sons, Inc., New York. It explains automatic control, measurement and process in a language that is understandable to the student and worker and valuable as a guide and reference for the processor and his technicians. Subjects covered include: Measuring means of industrial controllers, characteristics of measuring means, modes of automatic control, final control elements, process characteristics theory of automatic control, quality of automatic control, application of control engineering, automatic control systems, maintenance of exact control. The volume ends with a glossary of 126 terms and definitions. It also provides 119 references.

CREATION of miniature tropics—moss, rotting vegetation, bacteria, steaming jungle heat and all—in hundreds of glass jars by Dr. Peter Gray, biologist at the University of Pittsburgh, was a vital factor in the war against Japan and the war against nature. The experiments are part of a tropicalization program sponsored by the university, the Westinghouse Electric Corp., several other large concerns, and branches of the armed services. Radar and radio equipment, switchboards, transformers and hundreds of other kinds of apparatus which went into the Pacific war theater in huge quantities had to be made to stand up under assaults by fungi and bacteria, as well as extremes of temperature and humidity. With room temperature maintained at 90 F., the bottom of each jar is covered with moss which is kept saturated with water to attain a humidity fluctuating between 60 and 80 per cent. Small chunks of bread are placed atop the moss and an airtight lid affixed to the jar. The mold that soon forms upon the bread then is infected with other types of organic growth, and the various little "gardens" are allowed to germinate. When fungi, bacteria, mites and other organisms common to that hot, humid atmosphere have reached a robust stage, the biologist places samples of equipment in the jars. Daily microscopic examinations follow and detailed records are kept of the damage occurring to each sample of material. Because the interiors of the "junior hothouses" represent hostile climates and organic growths at their exaggerated worst, a month upon one of Dr. Gray's artificial islands is estimated to equal six months to a year's exposure in the Panama Canal Zone.

SUCCESSFUL metallizing repairs that save time, money and trouble on a wide variety of power plant equipment units, such as turbine runners, generator shafts, centrifugal pumps, motor shafts, guide sleeve bearings, valve spindles, etc., are described in detail in an article entitled, How to Get the Most Out of Metallizing in Power Plants by L. McWilliams, Master Mechanic, The Shawinigan Water & Power Co., published in the September-October, 1945 issue of Metco News.

MYODYNAMICS, the science of human muscles in action, involves some of the most interesting and important engineering principles known to man. For almost twenty years it has been the work of the Myodynamic Laboratory of the University of Rochester School of Medicine to study the foot in action and to develop evaluation techniques in this previously untouched field. Precision instruments have been developed for recording human gait and for analyzing shoe lasts in relation to the functional needs of the foot. Details of the general methods used are given in the November, 1945 issue of the Industrial Bulletin of Arthur D. Little, Inc. Most of the adult population of the civilized world, says the report, have uncomfortable if not abnormal feet, in large part because it has not been possible to follow the advice given in 1889 by the English physician T. S. Ellis—"Let the form of the boot fit the foot *in action*." Data from the tests at Rochester are being used by two shoe companies for further experimentation in the production of shoes. It is hoped that wide-spread use of these instruments and data will help standardize shoe characteristics to provide shoes that will prevent rather than relieve foot disorders.

HOW THE RECENT eclipse of the sun on July 9, 1945 revealed solar secrets about atmospheric electricity is told in a well-illustrated article by J. T. Wilson, Engineering and Development Division, Allis-Chalmers Mfg. Co., in the September, 1945 issue of Allis-Chalmers Electrical Review. An expedition, formed specifically to study electrical changes in the earth's atmosphere which might occur during and following the eclipse, was sent to the God's Lake area at Hudson Bay, and Mr. Wilson describes in detail just how it operated and what equipment it used. The observers reported significant changes in the potential gradient of the earth's atmosphere, probably resulting from the moon's shadow, which may have significant effects on electric power transmission equipment.

SILICA GEL Did Its War Work Well, says R. G. Skerrett in the November issue of Compressed Air magazine. The development of this material, first discovered in 1860 by a Scottish chemist, Thomas Graham, and further developed during the first World War by Dr. Walter A. Patrick for use in gas masks, is in itself an interesting story. But in the second World War, silica gel, known by various names such as Protek-Sorb and Tell-Tale, has been widely and effectively used to keep all kinds of war equipment protected against the bad effects of moisture. Methods of packaging have been worked out to include the necessary quantities of silica gel to adsorb moisture in the package and maintain the relative humidity inside it at a very low value. It has proved of great aid in shielding various products from deterioration caused by moisture. Complete details of the process are given in Mr. Skerrett's article.

NON-FERROUS FORGINGS in War Armaments are described in detail, with many illustrations, in the November, 1945 issue of Non-Ferrous Forgings Digest.

PREVENT RUST and SLUDGE in your turbines

SHELL TURBO OIL IS FORTIFIED to prevent turbine rust and sludge.

Here's the first turbine lubricating oil to actually prevent sludging and rust.

Especially fortified, this oil provides unusual oxidation stability, which prevents the formation of sludge, prevents emulsion-forming products—makes the oil last longer.

Moreover, Shell Turbo Oil stops rust by adhering closely to the metal surfaces, keeping air and water away. And it does not foam.

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Before changing over to Shell Turbo Oil, give your system a thorough cleaning. You'll get even finer results and save money in the long run. The booklet above describes this quick, easy operation. Send for your complimentary copy.

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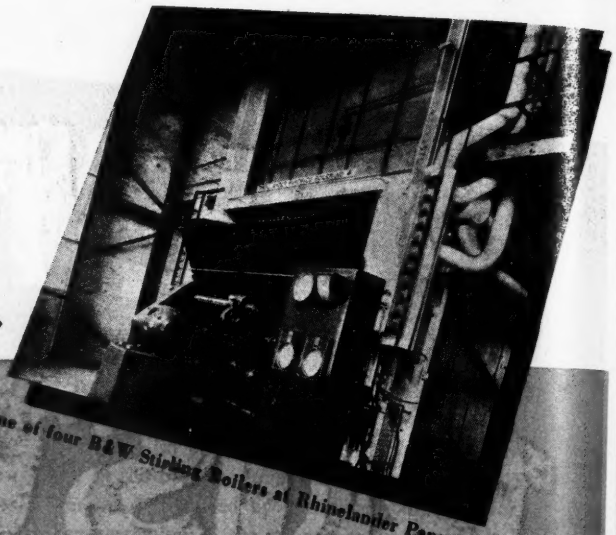
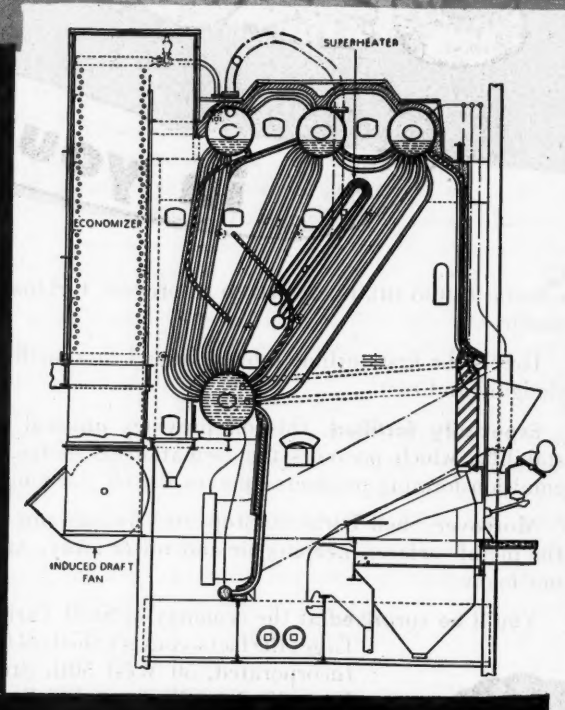


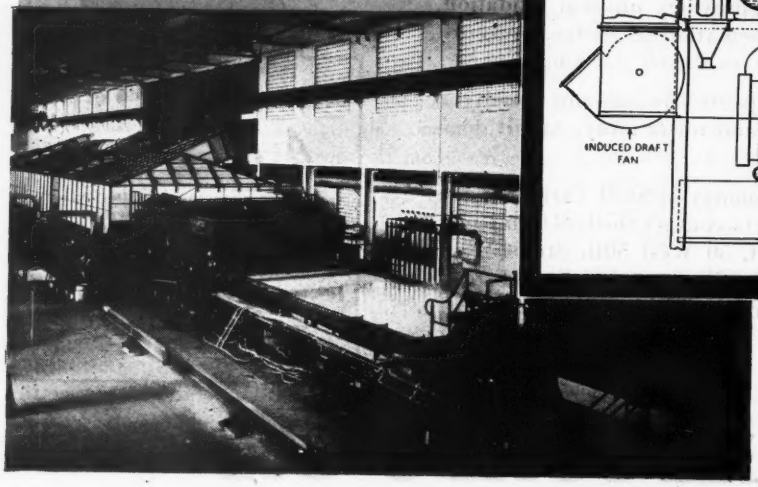
One of four B&W Stirling Boilers at Rhinelander Paper Co.

SAVES 20 TONS

Cross-sectional view of B&W Stirling Boiler, equipped with Water-cooled Walls, and B&W Economizer. Capacity—100,000 lb. of steam per hour at 425 lb. pressure and 550 F. total temperature.



General view of "The Big Swede", world's largest glassine paper-making machine. It is 280 feet long, 182 inches wide, and has top production speed of 750 feet per minute.



FOR "THE BIG SWEDE" ➡

Dry-end and calendar-section of "The Big Swede"

OF COAL DAILY

Power plant improvements, necessitated by the installation of "The Big Swede", famous 280-foot paper machine, have paid handsome dividends to the Rhinelander Paper Company in the form of coal savings and lower steam costs.

The prime factor in meeting the mill's increased steam demands, created by this giant machine, is a new 100,000 lb. per hour underfeed-stoker-fired Stirling boiler equipped with a B&W Economizer.

This new unit, together with other power-plant improvements, has effected a steady reduction in Rhinelander's steam costs to the present 35 cents per 1000 lb. Kilowatt-hour costs have also dropped substantially; efficiency of the new steam-generating equipment averages 82.5 per cent—*and coal savings are 20 tons a day.*

The performance of B&W steam-generating equipment has long been well known to the Rhinelander Paper Company. For several years prior to "The Big Swede" installation, three other Stirling boilers met the mill's growing load demands by operating at increasing ratings. Altogether, twelve B&W boilers have been installed at Rhinelander operations since that company's founding in 1903.

Similar instances of long-term satisfaction —and other case histories as impressive as "The Big Swede" story—have been accumulating in many industries for over 70 years. They indicate that boilers designed and built by B&W for all combinations of conditions—capacity, pressure, temperature, feedwater, fuel, and space—provide high-standard performance, continuity of service, high over-all station economy, and greatest return on initial investment.

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

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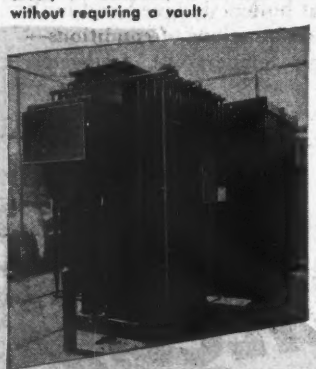
Load-center distribution system supplanting old-time system step-by-step will pay the full costs of replacement

Unit substations are easy to install; the use of Pyranol* or dry-type transformer sections, with safety metal-enclosed switchgear, permits them to be located on the factory floor adjacent to the load areas, on balconies, or in basements without requiring a vault.



Where building layout makes it desirable, unit substations are built for installation outdoors.

*Pyranol is the G-E trade mark (Reg. U. S. Pat. Off.) for askarel, a noninflammable, nonsludging insulating liquid.

Like many older plants of moderate size, this one was saddled with an obsolete power distribution system. A recent rise in power requirements, necessitating extensive additions to the old system, brought the problem of replacement to a head.

A study by G-E engineers showed the wastefulness of extending the outdated 2-phase system with 5-wire feeders such as originally used. Instead, they suggested a *step-by-step plan* for converting to load-center power distribution. This conversion plan is paying its own way right from the start.

1. The immediate need for extra power is being met with a new G-E load-center unit substation. The customer saved 5 per cent on first cost alone by buying standard three-phase equipment for the expanded main service. The total cost of *all* the three-phase high-voltage feeders was less than the cost of just the low-voltage two-phase extension, had the need been met by patchwork.

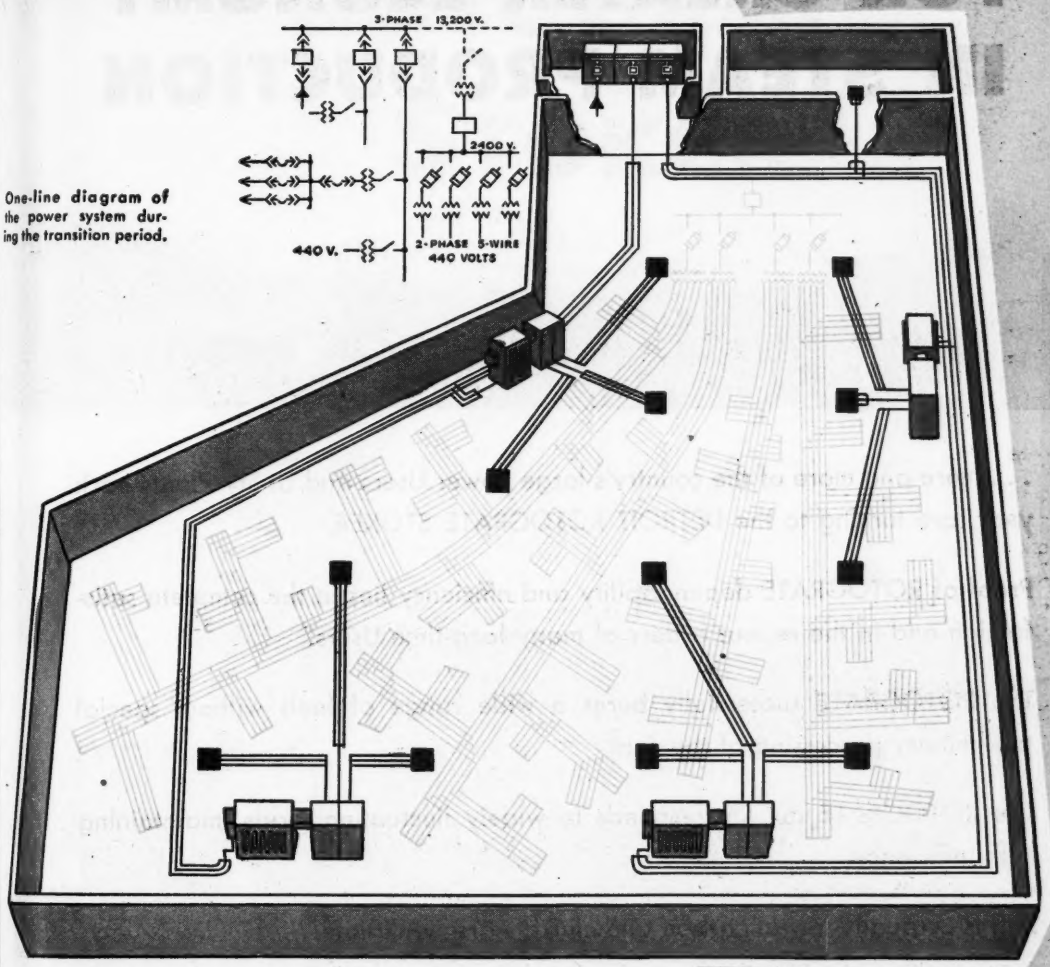
2. Later, additional load-center unit substations will be installed, until the old system is entirely supplanted. Savings resulting from the 2½ to 5 per cent extra efficiency of the three-phase system will amount to $2000 to $4000 per year in power costs alone. This will pay off the costs of complete modernization at some 20 per cent per year.

The changeover is being made without production shutdowns during installation of the three-phase system, or in the changeover from the obsolete system. The new system will be safer, and require less servicing time. When completed, the customer will have a power distribution system *engineered for growth,* whatever the extent of the plant's future power needs.

What does a check-up of your own power distribution system show as to voltage conditions, outages, maintenance costs, and restrictions on plant expansion? Perhaps modernization the load-center way can be planned so as to be fully self-liquidating. Ask your local G-E representative, or write for Bulletin GEA-3758. *Apparatus Dept., General Electric Company, Schenectady 5, N. Y.*

KEEP ON BUYING BONDS — AND KEEP ALL YOU BUY

FOR GROWTH



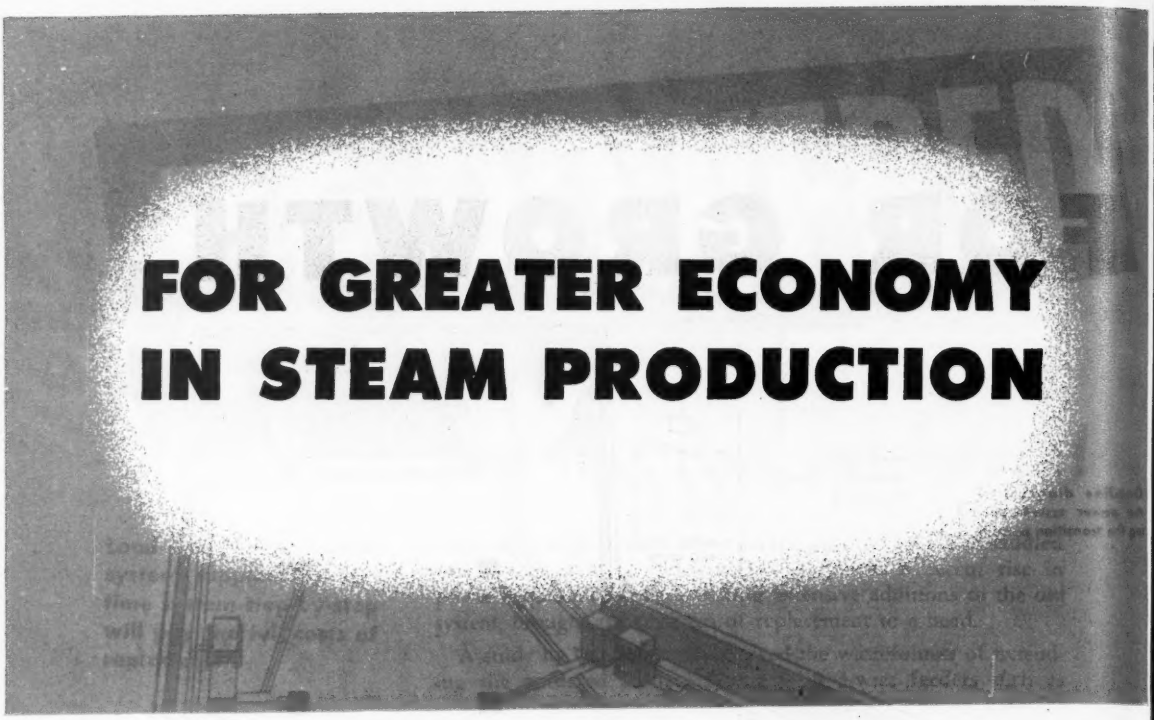
One-line diagram of the power system during the transition period.

New feeders (black) will replace the old feeders (yellow) and establish a simplified, modern distribution system.

GENERAL ELECTRIC

321-42-5900

LOAD-CENTER POWER DISTRIBUTION SYSTEMS



FOR GREATER ECONOMY IN STEAM PRODUCTION

. . . more and more of the country's large Power Users and Utility Plants each year, are turning to the DETROIT ROTOGRATE STOKER.

Proof of ROTOGRATE dependability and efficiency lies in the complete satisfaction and in the repeat orders of many long-time Users.

The ROTOGRATE successfully burns a wide range of fuels without special preliminary processing of the coal.

The ROTOGRATE quickly responds to widely fluctuating loads, maintaining high efficiency.

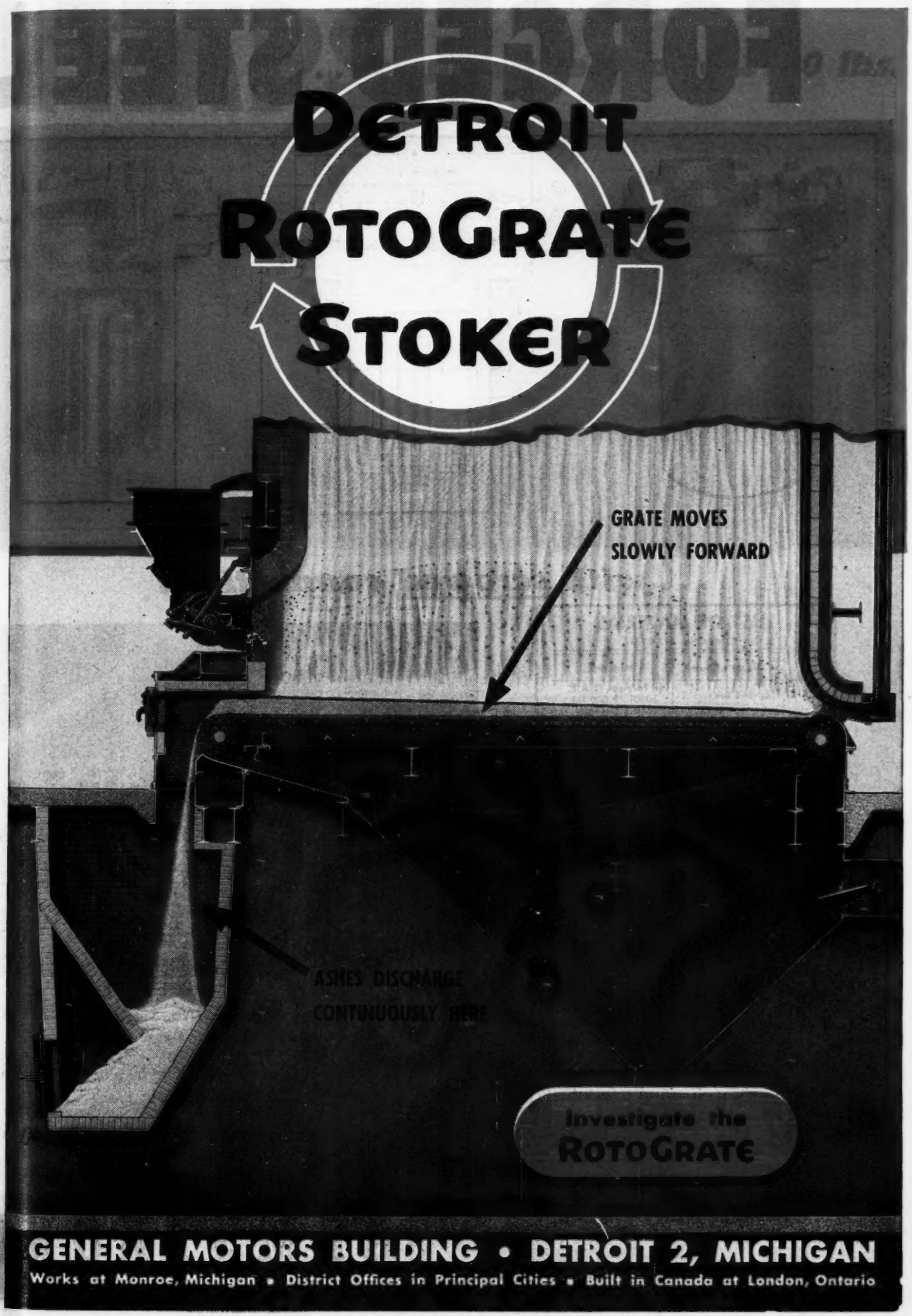
Ash is unusually low in carbon and clinkers are negligible.

Maintenance and power costs are unusually low.

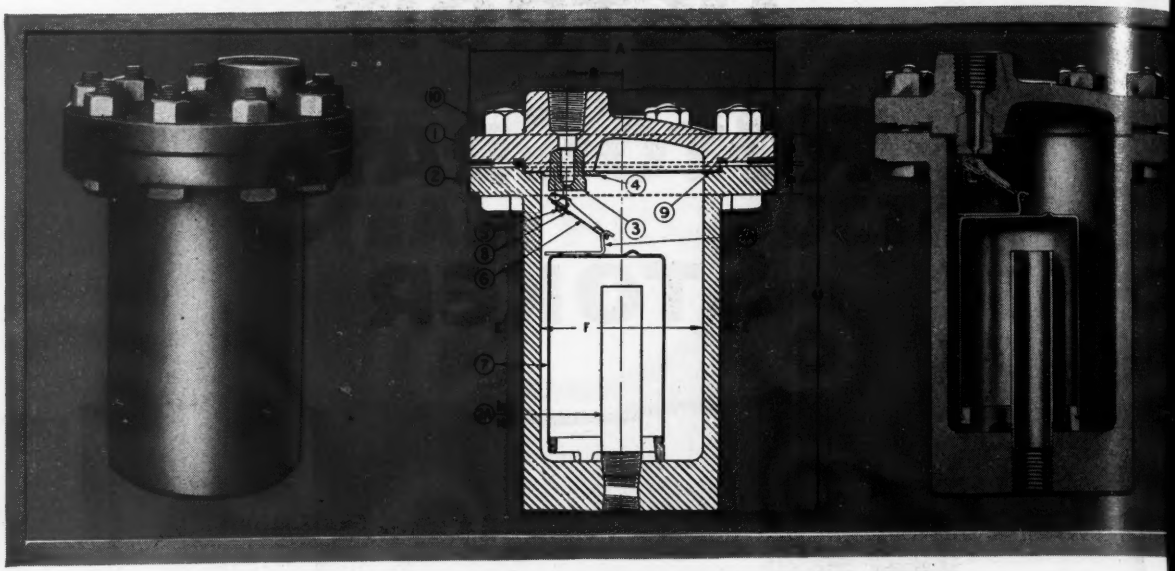
INVESTIGATE THE ROTOGRATE in the interest of economy and better performance.

Our engineers will gladly explain its many advantages, without obligation.

DETROIT STOKER COMPANY


DETROIT
ROTOGRATE
STOKER
GRATE MOVES
SLOWLY FORWARD
ASHES DISCHARGE
CONTINUOUSLY HERE
Investigate the
ROTOGRATE
GENERAL MOTORS BUILDING • DETROIT 2, MICHIGAN
Works at Monroe, Michigan • District Offices in Principal Cities • Built in Canada at London, Ontario

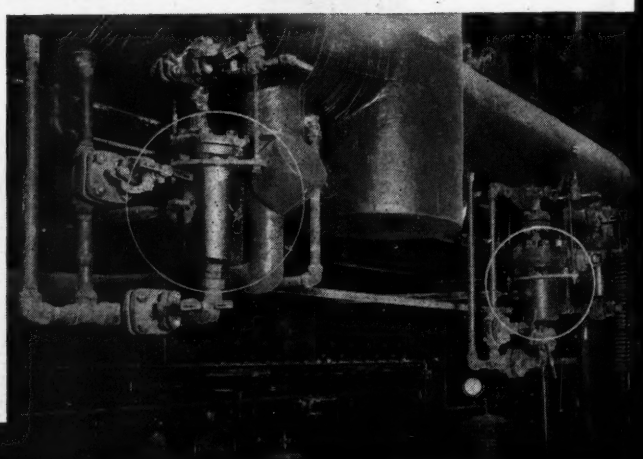
FORGED STEEL

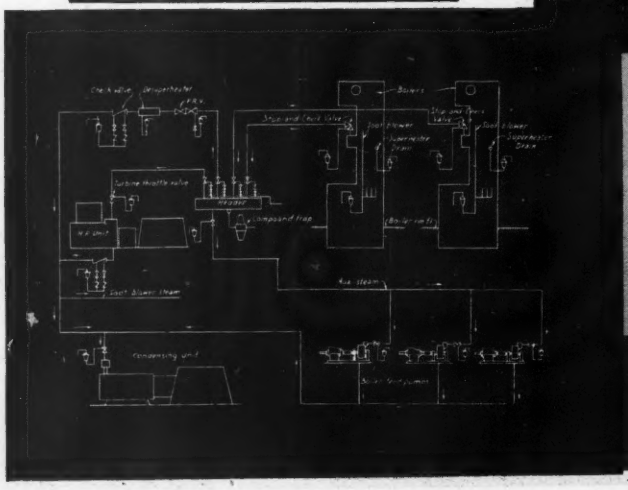


. . . with screwed connections

LIST OF MATERIAL
(Traps No. 312-513)

Part No.	Name of Part	Material
1 & 2	Cap and Body	Die Forgings (S.A.E. 1030) 79,000 lbs. Tensile Strength
2A	Inlet Tube	Wrought Iron
3	Valve Seat	Chrome Steel (Heat Treated)
4	Guide Pin Assembly	18-8 Stainless Steel
5	Valve	Chrome Steel (Heat Treated)
6	Lever	18-8 Stainless Steel
7	Bucket	18-8 Stainless Steel Cap & Tube—Cast Iron Bottom Weight
7A	Bucket Hook	18-8 Stainless Steel
8	Valve Retainer	18-8 Stainless Steel
9	Gasket	Compressed Graphited Asbestos
10	Bolt & Nut Set	Bolts Supertemp Steel, 149,000 lbs. Tensile, nuts hex. semi-finish (S.A.E. 1030)



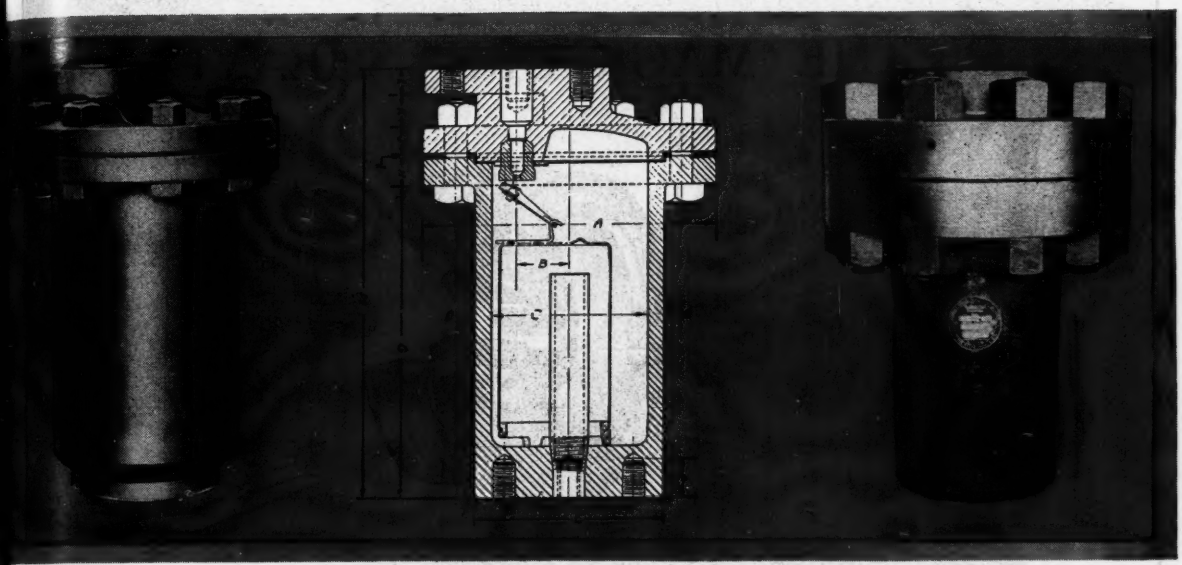


Above — Armstrong No. 315 and 515 Forged Steel Traps in a central station.

Left — Typical Armstrong trap applications in a modern power plant.

Right — Armstrong Forged Steel Traps at a Midwest utility plant.

TRAPS...*or pressures up to 2400 lbs.*



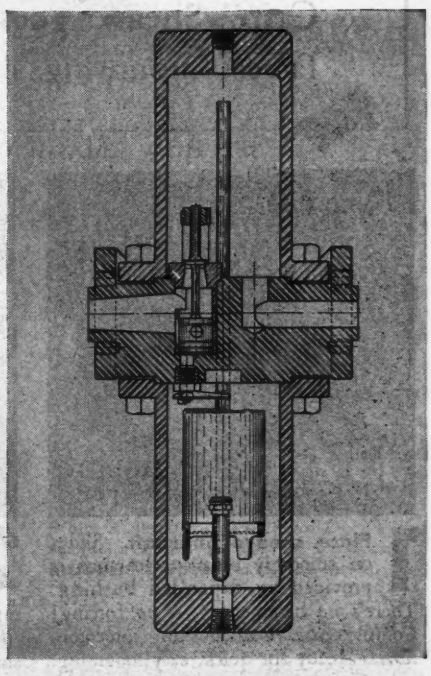
. . . with *flanged* connections

DEVELOPMENT over a period of years of the Armstrong line of forged steel steam traps has gone along with two trends in modern power plant design:

1. Elimination of all cast iron fittings.
2. Completely automatic condensate drainage.

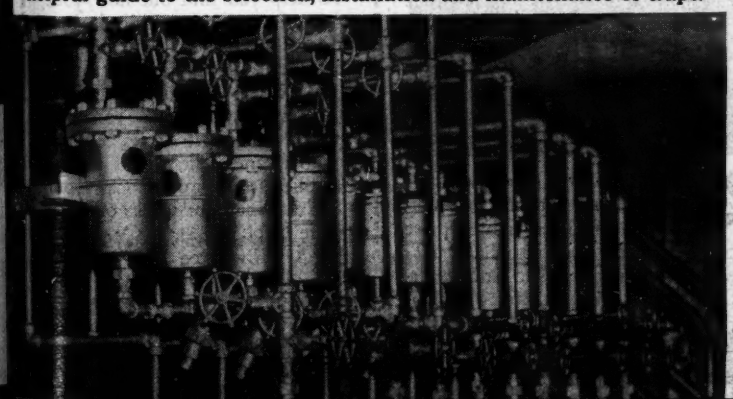
Here are traps engineers like. Simple — dependable. High quality materials. Well designed and well built. A size and type for every application. Backed by nearly 40 years' experience and an unconditional guarantee.

Ask for a copy of the Armstrong **STEAM TRAP BOOK**, a helpful guide to the selection, installation and maintenance of traps.



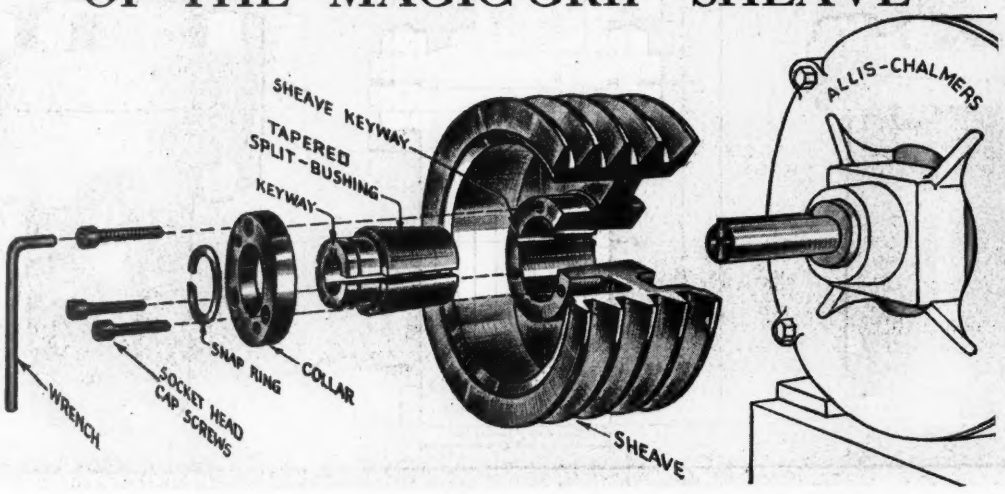
Armstrong Compound Trap

For large amounts of condensate. Capacities to 300,000 lbs. of condensate per hour at pressures to 600 psi. For draining steam purifiers and separators, flash tanks, continuous blow down systems, etc.



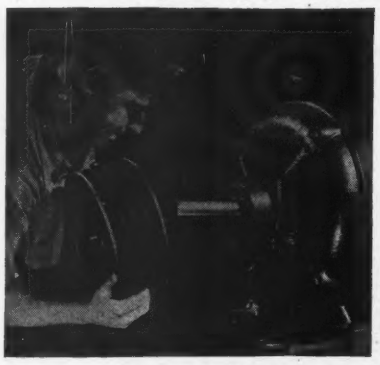
Here's the Inside Story

OF THE "MAGIC-GRIP" SHEAVE

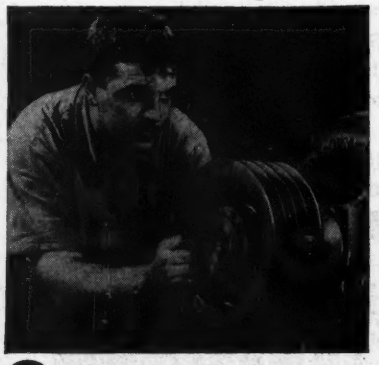


Exploded view shows why Allis-Chalmers' new "Magic-Grip" Sheave goes on *as a unit in 2 easy steps.* It's the fastest mounting sheave on the market—at no extra cost.

SEE HOW "MAGIC-GRIP" GOES ON QUICKLY AS A UNIT IN 2 EASY STEPS



1 **Place sheave on shaft.** Slides on smoothly because clearance is provided by expanded bushing. There's *no* hammering — *no* forcing! Complete sheave and bushing unit comes intact—ready for quick, easy mounting.



2 **Align exactly,** using straightedge, (It's easy with this free-sliding sheave.) Then tighten three capscrews; sheave is locked to shaft, *grips like magic!* No set screws to damage the shaft. Write for Bulletin B6310.

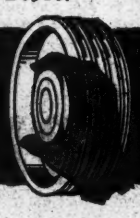
RECONVERTING?

GET THIS NEW FREE KIT!

To help you find out how your present equipment will fit into future production, A-C offers a new free "Reconversion Inventory Kit" — Fact Sheets and Check Lists to speed your appraisal of V-belt drives, electric motors, and centrifugal pumps. Applies to all makes. Call your A-C distributor or district office, or write Dept. 38, ALLIS-CHALMERS MFG., Milwaukee 1, Wisconsin.

A 1858

Allis-Chalmers Texrope

"MAGIC-GRIP"  **SHEAVES**

HEAR THE BOSTON SYMPHONY: *Saturday, American Broadcasting Co.*

Protect your Open Gears with this Black Magic that . . .

NO WONDER these Gargoyle Viscolite Fluids are called "Black Magic"! Here's the magic they work:

Containing a volatile, non-inflammable diluent, they flow like oil without the necessity of heating. Thus, they can be painted on with a brush, poured from a can or applied with drip-oilers or mechanical force-feed lubricators.

Once on the gears, they distribute quickly and evenly. Then as the diluent evaporates, the remaining product forms strong, viscous, adhesive films that resist rupture, cushion shock loads, promote quiet operation.

As fluids, the Viscolites are easily applied—without waste. As adhesive films they minimize loss from the wiping, squeezing actions of meshing teeth. This permits long intervals between hand applications, minimum rates of feed with automatic oilers.

Get "Black Magic" for maximum protection of your open gears.

SOCONY-VACUUM OIL CO., INC.
Standard Oil of N. Y. Div. · White Star Div. · Lubrite Div. · Chicago Div. · White Eagle Div. · Wadhams Div · Magnolia Petroleum Co. · General Petroleum Corporation of California.

GARGOYLE Lubricants

SOCONY-VACUUM'S 5 Steps to Lower Production Costs.

1. Lubrication Study of Your Entire Plant
2. Lubrication Schedules and Controls
3. Lubricant Storage and Handling System
4. Skilled Engineering Counsel
5. Progress Reports of Benefits Secured

TUNE IN "INFORMATION PLEASE"—MONDAY EVENINGS, 9:30 E.S.T.—NBC

the temperature of two valves

warned the Hall engineer of trouble ahead—

It was a routine inspection of the boiler room at an electric plant in the South. Everything seemed in excellent condition that afternoon—until the Hall engineer casually touched two valves near the flash tank on the continuous blowdown line from one of the boilers.

The valves (1) should have been hot. Instead, they were merely lukewarm—and the Hall engineer knew that meant that something was wrong.

Questioning brought out the fact that when one of the turbines had been opened a short time before, slight deposits had been noticed on the blades. The Hall engineer therefore arranged to have the boiler taken off the line at once.

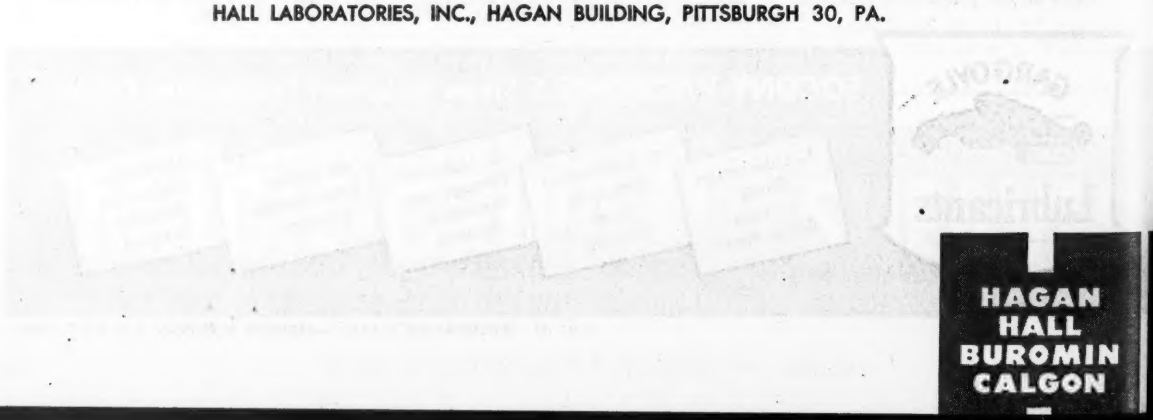
Pinholes drilled each side of the blowdown control valve (2) showed that water was reaching the valve, but not getting through. When the valve was removed, it was found that the disc on the valve stem had fallen *into* the seat. Apparently it had come loose some weeks earlier, but the pressure of the water had held it up. A few days before the inspection the boiler had been off the line for a while, and this had permitted the disc to fall and block the line.

Water tests had been made regularly, but, as the diagram shows, samples thought to be from #12 boiler were actually of water from #11 which had backed up from the 3″ line. The two sets of samples differed enough to have come from different boilers because the flashing of some water into steam on entering the 3″ line caused a slightly different concentration in the false sample.

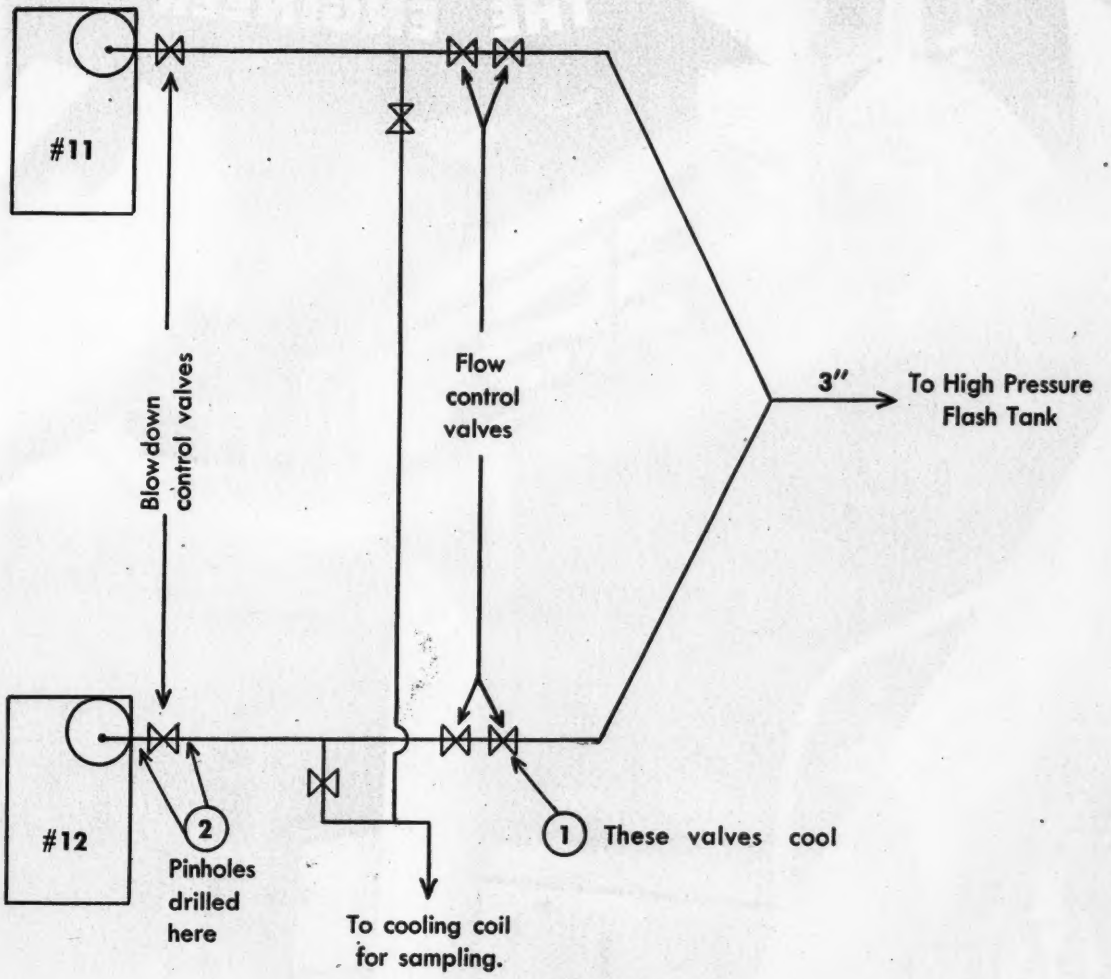
Thus the high concentration which built up in the boiler water of #12 boiler because of lack of blowdown was not detected. Thanks to the Hall engineer's quick reaction, however, trouble was averted, and the boiler was back on the line the next morning.

Every plant that generates its own steam can profitably use Hall service. Write us for full information.

HALL LABORATORIES, INC., HAGAN BUILDING, PITTSBURGH 30, PA.



HAGAN
HALL
BUROMIN
CALGON

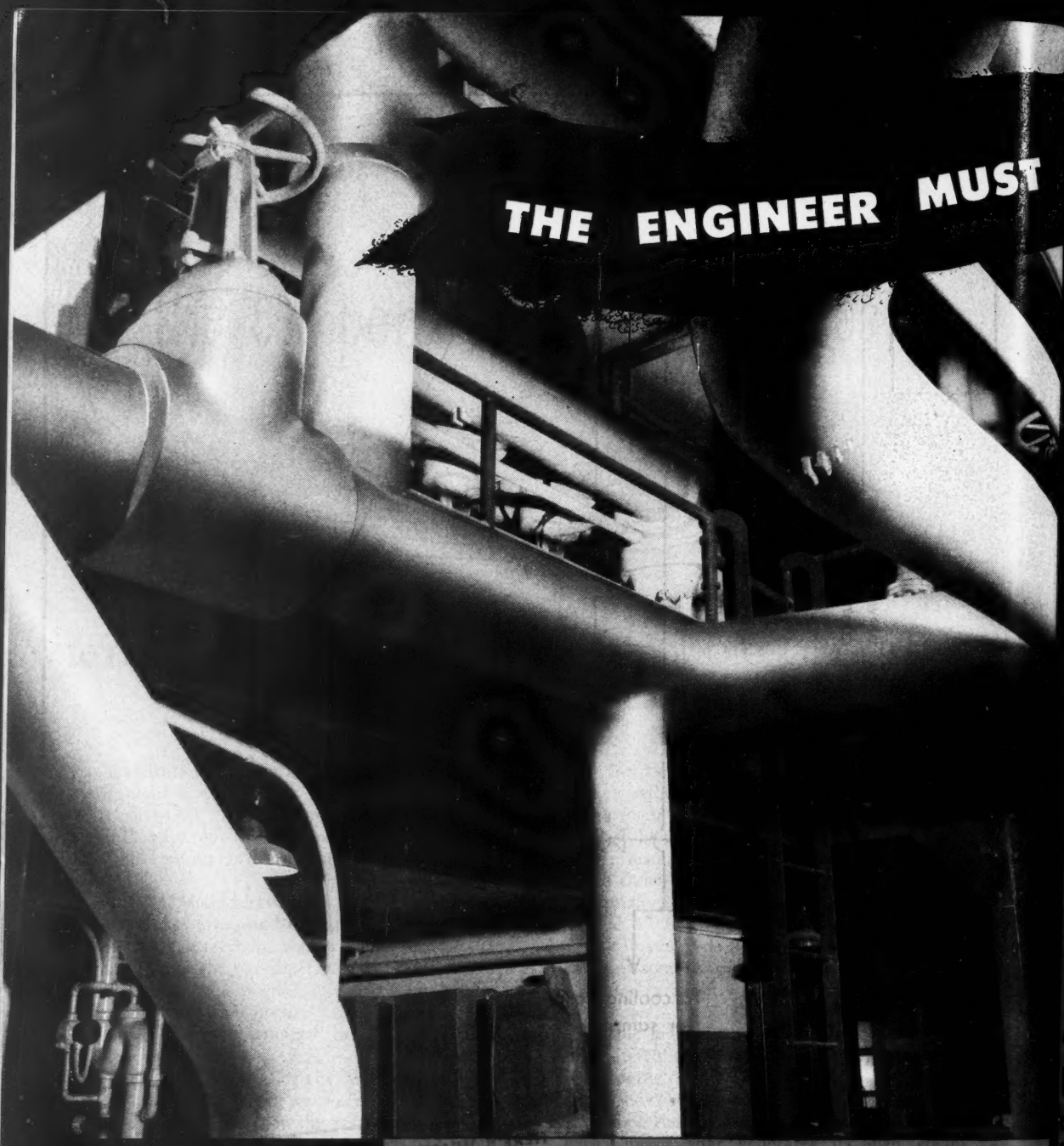


HERE'S WHAT HALL CLIENTS GET:

1. Thorough study of all factors concerning water involved in producing steam.
2. Procedure for the proper treatment of boiler water.
3. Instruction of designated employees in making of essential control tests.
4. Periodic check up by Hall service engineers.
5. Periodic checking of samples by Hall Laboratories.
6. "Trouble shooting" that includes all service necessary as problems arise.

. . . all of which adds up to *boilers that stay on the line!*

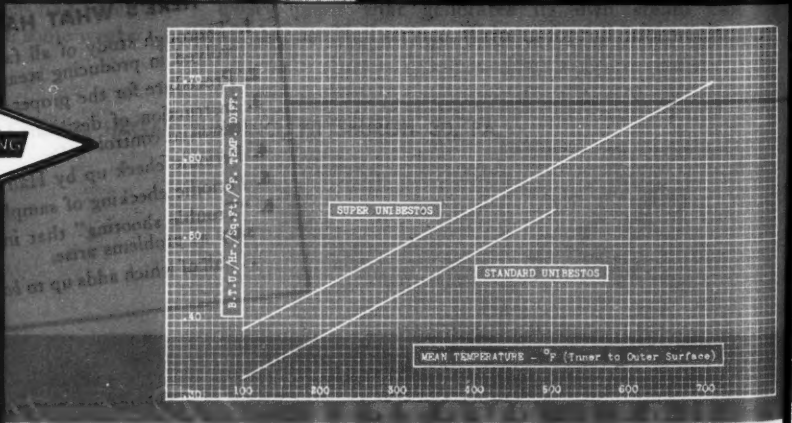
HALL SYSTEM *of Boiler Water Conditioning*



UNION ASBESTOS
MEANS PROGRESS IN INSULATION AND PACKING
AND RUBBER CO.

PLANTS: 1821 S. 54th Ave., Cicero, Ill.; Paterson, N. J.; Blue Island, Ill.

OFFICES: Cicero, Ill., Chicago, Ill., New York, N. Y., San Francisco, Calif.



These Thermal Conductivity Curves tell the story!

THINK OF EVERYTHING

MORE ATTRACTIVE
MORE EFFICIENT
MORE ECONOMICAL

UNIBESTOS The Sectional Insulation

Unibestos is the *favorite* insulation because it is easier to apply (it's *the* half-section insulation) and more efficient (consequently more economical, both in application and in use) and because it makes for a better looking job. It won't sag, gap, shatter or shakedown under the most severe vibration—is unaffected by moisture. Unibestos saws or cuts clean and sharp with ordinary tools — provides a smooth, neat, efficient insulation.

For a step-by-step picturization of the application of Unibestos, write for your copy of "Efficiency"—bulletin No. 48-974.

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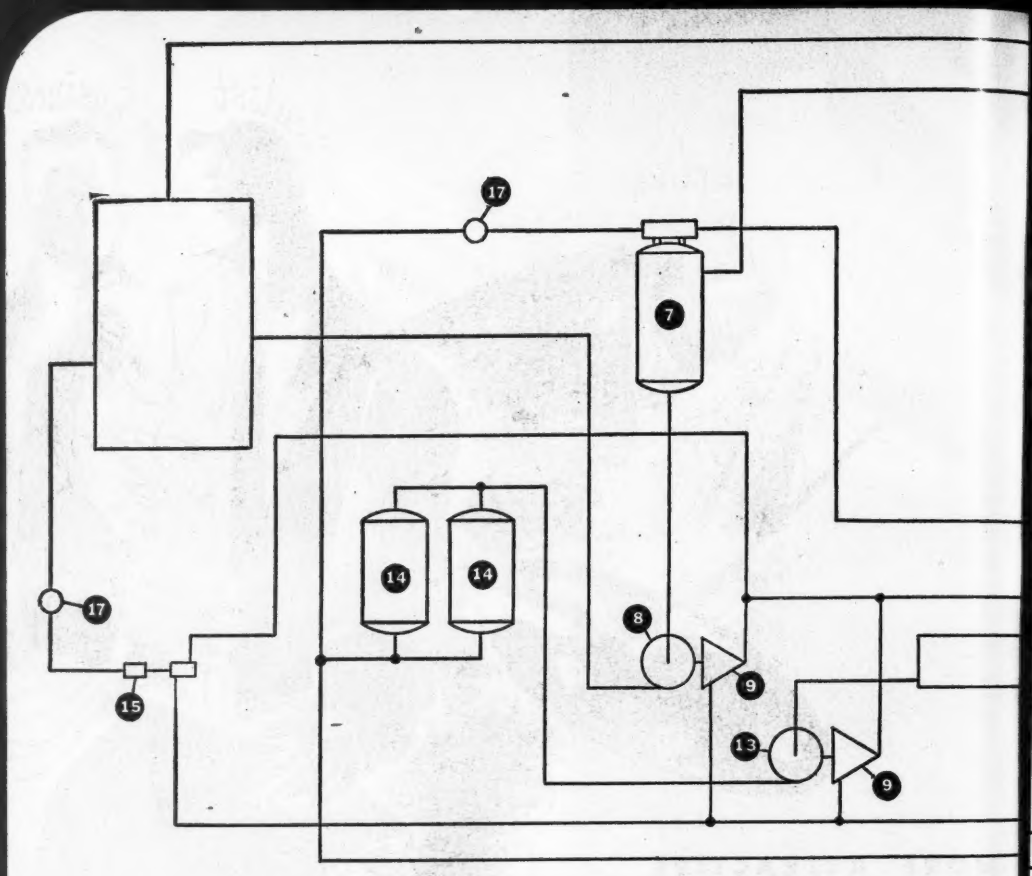
Union Asbestos & Rubber Co.

IT'S WORTHINGTON...



1 Extraction Turbine.
2 Generator & Exciter.
3 Switchgear.
4 Condenser.
5 Condensate Pump.
6 Steam Jet Air Ejector.
7 Deaerator.
8 Boiler Feed Pump.
9 Mechanical Drive Turbines.

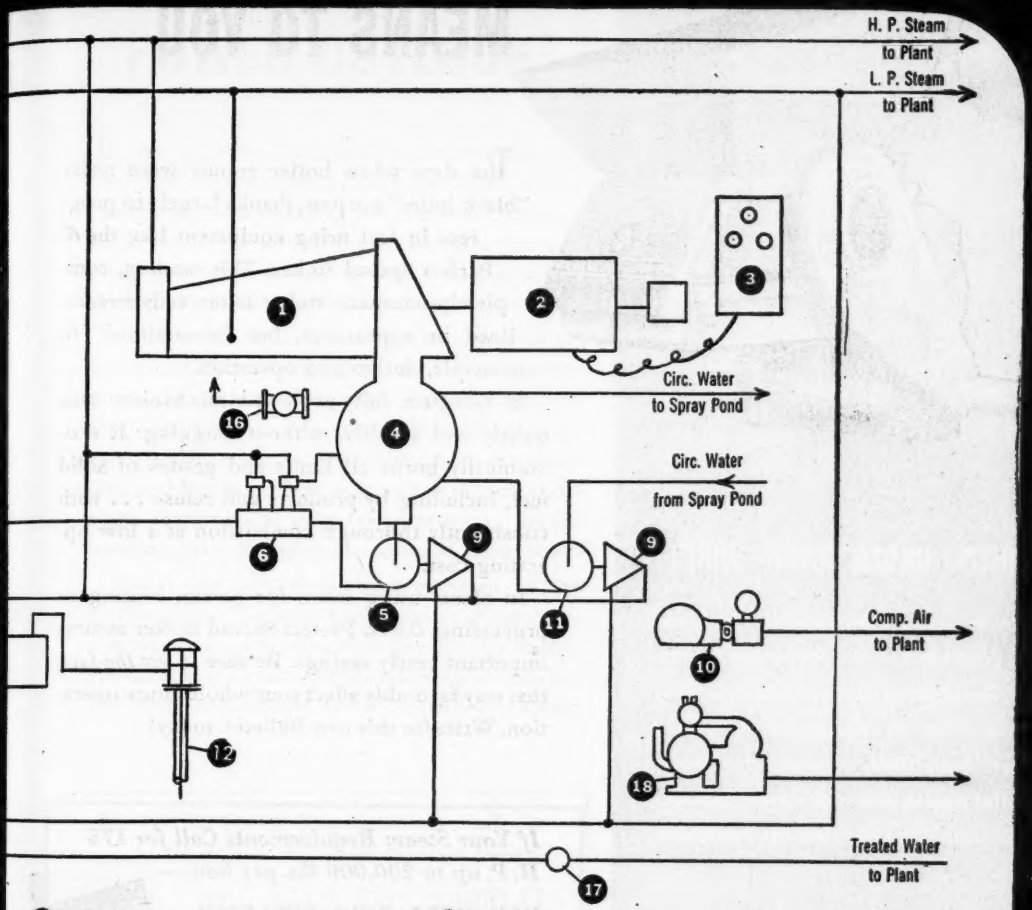
18 *Major Items of Equipment for Steam Power Plants Are Products of Worthington*

When planning equipment for steam power plants, the name Worthington becomes a logical consideration, because the Worthington line is the most complete . . . backed by engineering staffs that have been responsible for many of the important advancements in the handling of steam and water in power plants.

The flow sheet, representing a typical steam power plant of approximately 7500 kw. capacity, suggests the various items of equipment available under the Worthington trade-mark.

If you have known of Worthington through experience with any one of their products, you will be interested to learn about other types manufactured by the same company. Worthington engineers specializing in equipment for steam power stations are available in all parts of the world. Send the coupon today for information that may serve as the first step in experiencing why *there's more worth in Worthington.*

in Steam Power Plants



10 Compressor with Synchronous Motor.
11 Circulating Water Pump.
12 Deep Well Pump
13 General Service Pump.
14 Ion Exchange Softeners.
15 Fuel Oil Pumps.
16 Atmospheric Relief Valve.
17 Meters.
18 Air Conditioning and Refrigeration Equipment.

WORTHINGTON

FIRST IN STEAM POWER

WORTHINGTON PUMP & MACHINERY CORPORATION
Harrison, N. J.

Please send me, without obligation, literature on items checked below.

① ② ③ ④ ⑤ ⑥ ⑦ ⑧ ⑨
⑩ ⑪ ⑫ ⑬ ⑭ ⑮ ⑯ ⑰ ⑱

NAME .....

COMPANY .....

ADDRESS .....

☐ *Check here to have a Worthington representative call.*

What

STOKER STREAMLINING MEANS TO YOU

The days when boiler rooms were noisy "black holes" are past, thanks largely to progress in fuel firing equipment like the Æ Perfect Spread Stoker. This modern, completely automatic stoker is not only streamlined in appearance, but "streamlined" in principle, design and operation.

Its compact, fully-protected mechanism runs quietly and steadily, without clogging. It economically burns all kinds and grades of solid fuel, including by-products and refuse . . . with consistently thorough combustion at a low operating cost.

In plants using steam for power, heating or processing, the Æ Perfect Spread Stoker assures important yearly savings. Be sure to *get the facts* that may favorably affect your whole future operation. Write for this new Bulletin, today!

STREAMLINED—UNDER COVER—QUIET!

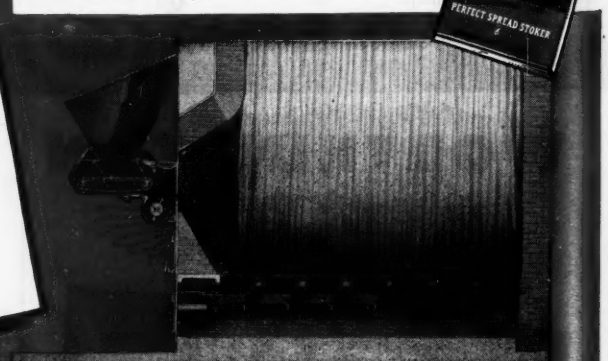
The all-enclosed, protected mechanism includes automatic, variable-speed feeder with non-clog safety feature and is accessible without tools for inspection or adjustment by merely lifting cover. Simplified construction, water cooling at vital points, and many other features add up to unusually quiet, efficient operation.

If Your Steam Requirements Call for 175 H. P. up to 200,000 lbs. per hour—

YOU NEED THIS BULLETIN

Write us. 2408 Aramingo Ave., Philadelphia 25, Pa.

Æ PERFECT SPREAD STOKER



AMERICAN ENGINEERING COMPANY

PHILADELPHIA 25, PENNSYLVANIA

15 MINUTES

MAY ALTER YOUR POWER OUTLOOK!

The few minutes it will take you to examine the new booklet describing the Improved Æ Taylor Stoker may mean much to you and your company. In it you'll see new features that add years of progress to the design, operation and performance of this time-tested stoker.

You'll see how simplified unit construction reduces installation costs; how the unique continuous ash discharge is automatically timed; how slag formation is minimized; how "finger-tip" ash discharge becomes a reality; how precision feed and better air flow maintain uniformly thorough combustion; how fewer moving, longer wearing parts contribute to lowered steam costs.

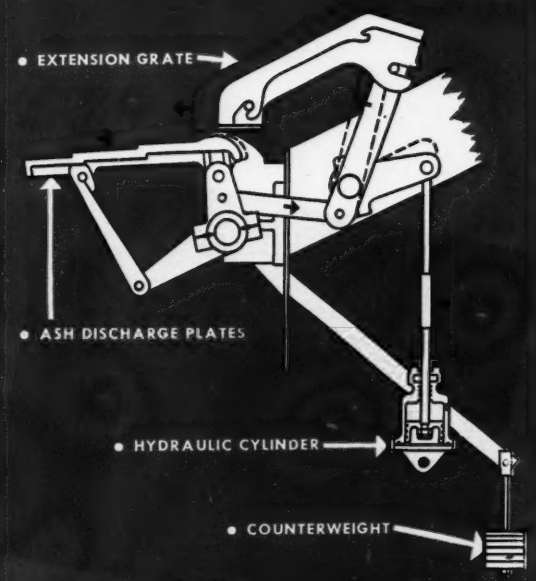
You'll see why these improvements in the Taylor Stoker logically provide even greater efficiencies and economies than previously. Before you decide on *any* equipment take time to send for and study this booklet. It will be time well spent.

IF YOUR Steam Requirements Call for 20,000 to 500,000 lbs. per hour—

YOU NEED THIS BOOKLET

Write us. 2408 Aramingo Ave., Philadelphia 25, Pa.

ANOTHER IMPROVED FEATURE OF THE TYPE "R" TAYLOR STOKER



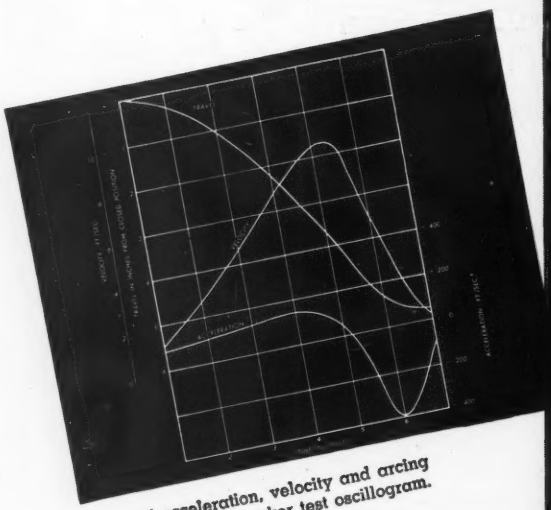
Hydraulically driven independent of the main stoker drive, reciprocating discharge plates provide ash movement ALL-THE-WAY TO THE END OF THE STOKER.

Rearward and slightly upward movement of overfeed section effectively moves ash onto the discharge plates. When overfeed section completes rearward travel, continuation of ash movement to point of discharge is assured by rearward travel of discharge plates.

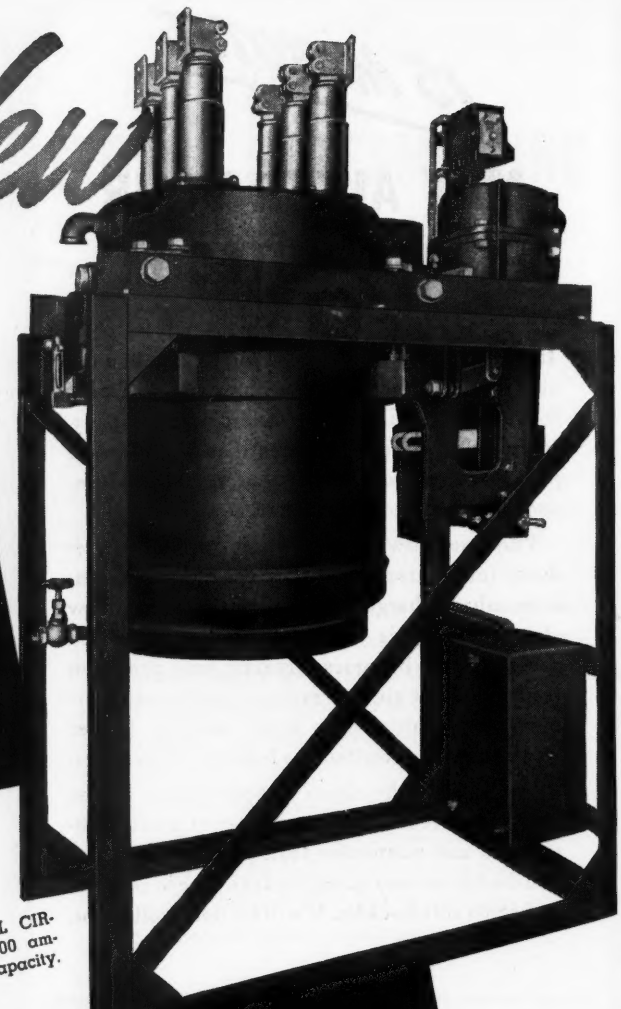
Æ
TAYLOR STOKERS
AIR-COOLED & WATER-COOLED

AMERICAN ENGINEERING COMPANY
PHILADELPHIA 25, PENNSYLVANIA

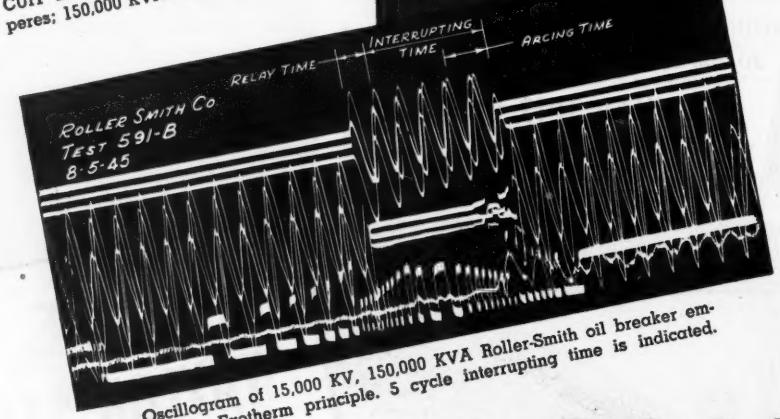
New



Curves of acceleration, velocity and arcing time derived from breaker test oscillogram.



150 TCR 5 EXOTHERM TYPE OIL CIRCUIT BREAKER; 15,000 volts, 1200 amperes; 150,000 KVA interrupting capacity.



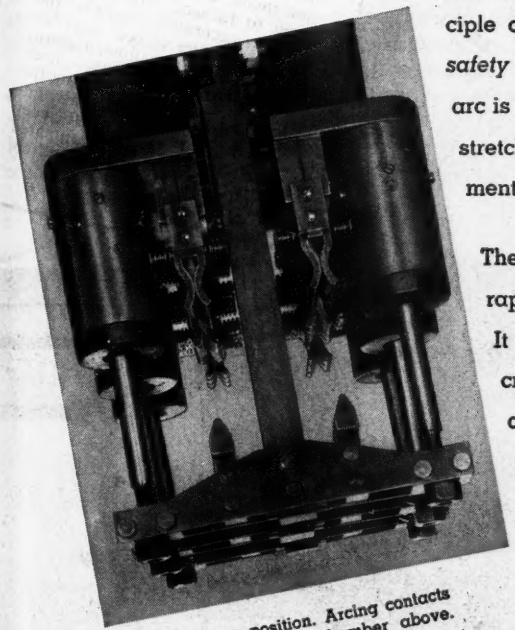
Oscillogram of 15,000 KV, 150,000 KVA Roller-Smith oil breaker employing Exotherm principle. 5 cycle interrupting time is indicated.

ROLLER S

ROLLER SMITH

ROLLER-SMITH BREAKER

Gives 5 Cycle Opening with newly discovered EXOTHERM principle of Arc Extinction - - -



Breaker in open position. Arcing contacts shown with quenching chamber above.

THE new Roller-Smith oil circuit breakers with the Exotherm principle of arc extinction give 5 cycle opening consistently, *a 38% safety factor over present accepted standards.* That's because the arc is put out by use of its gas generated energy instead of merely stretching the arc. Users are assured greater protection to equipment by this higher opening speed.

The operation of a confining chamber to quench the arc rapidly is based on the known properties of gas conductivity. It decreases with decrease in gas temperature and also decreases with an increase in pressure. In the quencher the cooling of the arc extracts its energy and reduces the temperature. At the same time the enclosure builds up the gas pressure so that it becomes less conducting and the combination puts out the arc.

The greater speed on opening cuts down contact burning and thereby reduces contact maintenance. It also gives improved protection to equipment against short circuits because of the higher speed of opening.

Confining the gas within the quenching chamber to put out the arc keeps the pressure within the tank at a safe nominal value.

For full information on the Exotherm principle applied to Roller-Smith oil circuit breakers, write to dept. PPE-5

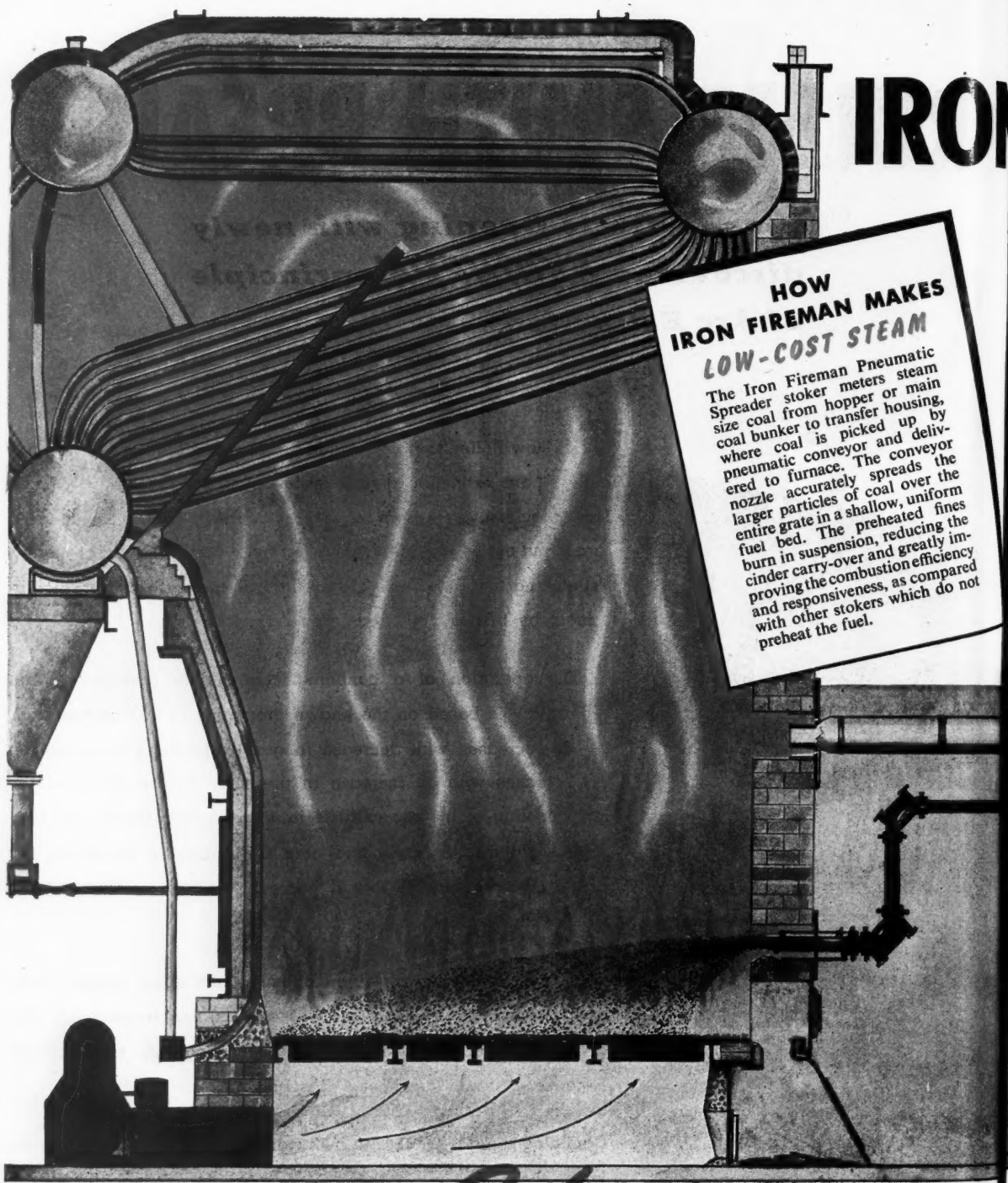
R SMITH

Oil Circuit Breakers

BETHLEHEM • PENNSYLVANIA

In Canada: Roller-Smith Marsland, Ltd., Kitchener, Ontario

STANDARD AND PRECISION ELECTRICAL INSTRUMENTS • AIRCRAFT INSTRUMENTS • SWITCHGEAR
AIR AND OIL CIRCUIT BREAKERS • ROTARY SWITCHES • RELAYS • PRECISION BALANCES



HOW IRON FIREMAN MAKES *LOW-COST STEAM*

The Iron Fireman Pneumatic Spreader stoker meters steam size coal from hopper or main coal bunker to transfer housing, where coal is picked up by pneumatic conveyor and delivered to furnace. The conveyor nozzle accurately spreads the larger particles of coal over the entire grate in a shallow, uniform fuel bed. The preheated fines burn in suspension, reducing the cinder carry-over and greatly improving the combustion efficiency and responsiveness, as compared with other stokers which do not preheat the fuel.

IRON FIREMAN'S *3 fundamentals*

1 POSITIVE CONTROL OF FUEL FEED AND DISTRIBUTION

Rate of fuel feed is adjusted to the load at all times. Even distribution of coal (which is the very essence of successful spreader operation) is under accurate control regardless of size of grate or size consist of coal.

2 POSITIVE CONTROL OF AIR DISTRIBUTION & DIFFUSION

Iron Fireman combustion efficiency is due in large measure to its effective control of the air supply. Distribution of undergrate air is uniform over the entire grate area, and complete diffusion occurs within the fuel bed.

3 POSITIVE CONTROL OF FUEL-AIR RATIO

The volume of air passing through fuel bed is always correctly metered, despite variations normally occurring in fuel bed resistance. Correct ratio of fuel and air abates smoke and prevents the formation of clinkers.

IRON FIREMAN

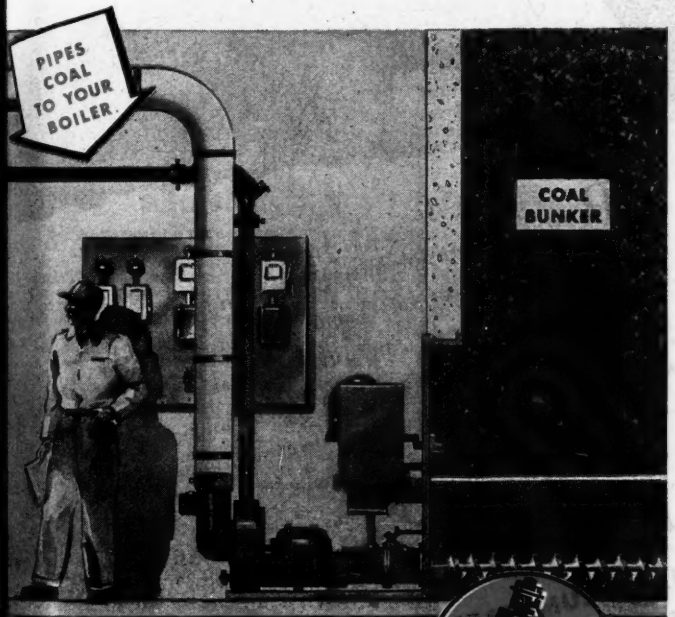
PNEUMATIC SPREADER STOKER

—for quick pick-up
—steady steam pressure
—low maintenance
—low cost power

IRON FIREMAN'S quick response to automatic controls makes this stoker readily adaptable to the most diverse operating conditions. Many Iron Fireman installations maintain the requisite steam supply even when requirements vary within the space of a few minutes from a minimum stand-by load to maximum capacity. Throughout the whole firing cycle the same high combustion efficiency is maintained by sensitive, positive control of all factors of combustion. All mechanical parts of the Pneumatic Spreader stoker are readily accessible, and all furnace parts are protected against direct furnace temperature. Iron Fireman's outstanding record of economical operation results from a combination of utilization of low cost fuel, high combustion efficiency, ample capacity, low labor costs, minimum maintenance and a high availability factor.

Nation-wide Engineering Service. Iron Fireman's engineering staff is a highly capable, fully manned organization that extends to all parts of the country. Each installation is engineered to the job, with furnaces and combustion chambers correctly proportioned to individual fuel and load requirements.

Free Boiler Room Survey. You can have an engineering survey of your own boiler room without cost or obligation. Write to Iron Fireman Manufacturing Company, 3851 West 106th Street, Cleveland 11, Ohio. Other plants in Portland, Oregon; Toronto, Canada. Dealers everywhere.



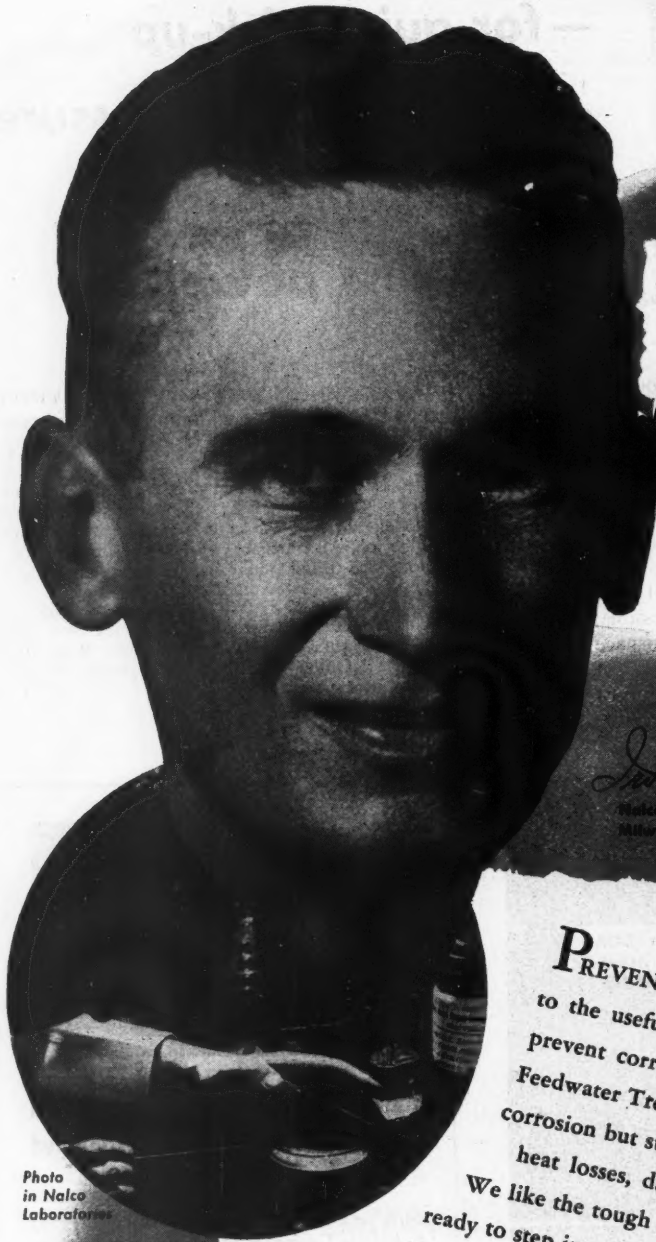
IRON FIREMAN

HEAVY DUTY STOKERS

American Pad & Textile Co. installed Iron Fireman in 1940 . . . doubled output with less fuel

Although the output of the American Pad & Textile Company plant was doubled by war production, Iron Fireman Pneumatic Spreader stokers carried the increased load with less fuel than was used by the former stoker equipment. Other benefits listed by this company are as follows:

1. Boiler upkeep cost reduced better than 50 per cent.
2. Steam pressure remains constant, with load fluctuating from 95% to 175% of boiler rating.
3. Iron Fireman successfully burns a cheaper grade of coal.
4. Cleaning grates can be easily done under full load without loss of steam pressure.



. . . here is one way
to extend the life
. . . of valves and pipes

Nalco Representative
Milwaukee, Wisconsin

Photo in Nalco Laboratories

PREVENT corrosion in steam lines and you add years to the useful life of valves and pipes. And, how do you prevent corrosion? . . . by using the Nalco System of Feedwater Treatment. The Nalco System not only prevents corrosion but stops scale and carryover with its subsequent heat losses, damage and shutdowns.

We like the tough jobs when it comes to water treating and are ready to step in and solve *your* problem. Remember, the Nalco System is always *keyed* to the particular job at hand. Get a Nalco survey today.

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Canadian inquiries should be addressed to
Aluminate Chemicals, Ltd., 555 Eastern Ave., Toronto, Ontario

The System of Scientific Water Treatment for All Industry

HELPFUL BULLETINS

Answers to many operating and maintenance problems will be found in these new bulletins and catalogs. List paragraph numbers of those you want on coupon below, detach and mail.

BOILER PLANT

1 **Packaged Steam Generator**—Bulletin FF describes the new Dutton Econotherm steam generator which is a completely self-contained, fully automatic unit. Three color illustration shows efficient fire travel through three passes, induced draft principle and Dutton fast-firing Rotary Combustion feature. Designed for oil or gas firing—150 HP. C. H. Dutton Co.

2 **Furnace Design Handbook**—New textbook type catalog entitled "Our Story" contains useful information on selection of refractories, heat losses with various types of furnace construction, thermal values of fuels, industrial heating hints, etc. Eastern Refractories Co., Inc.

3 **Cleaning Steam Heating Systems**—Folder describes the Pressure-Jet system which injects a vapor beyond the boiler; removes scale and sludge from the pipes, radiators, traps return lines and other steam operated equipment. Will not interfere with existing boiler compounds. Pressure-Jet Systems, Inc.

4 **Furnace Observation Door**—New Bulletin 30 lists 13 salient features of Bigelow-Liptak Type A furnace observation door. Has blue heat-resisting glass 7/32 in. thick. Bigelow-Liptak Corp.

5 **All Purpose Stoker**—Bulletin No. 500 describes advantage of the Canton De Luxe worm feed stoker for small and medium sized industrial and commercial applications. Features include side ash dumps, extra grate area, zoned air control, dur-alloy steel hopper. Canton Stoker Corp.

6 **Boiler Gauge Glass Protector**—Folder describes the Wright-Austin Kleervu gauge glass protector with a transparent cover that guards against injury from flying broken gauge glass. Easy to install. Wright Austin Co.

7 **Gas-Oil Burners**—Operating features and many actual installations of National Airoil burners are pictured in new Bulletin 745. Oil burners can be operated through a 10 to 1 range, efficiences being well maintained anywhere between 40% and 150% of rating. National Airoil Burner Co.

ELECTRICAL

8 **Electrical Equipment for Cotton Mills**—Slasher drives, lint-free motors, loom motors, and other electrical equipment for the textile industry are described in a new booklet announced by the Westinghouse Electric Co. Power-factor correction and lighting recommendation tables are included, as well as a table for quick selection of switch, circuit breaker, wire and fuse sizes for motor branch circuits.

9 **Handbook on Fuse Care**—A new 32-pg. catalog has detailed descriptions of construction of G-E non-renewable and renewable cartridge fuses, Silvend fuses and Pyrex plug fuses. One chapter deals with the operation of fuses and contains a technical description of short circuits, normal overloads, abnormal overloads, time-current characteristics of fuses and high interrupting capacity. Other chapters deal with fuse history and fuse care. General Electric Co.

10 **Fluorescent Lamp Ballast**—The American Transformer Company has released a 4-pg. folder describing AmerTran ballasts for fluorescent lighting and germicidal lamps. Included is a price list showing the various types, sizes and ratings. Also given are power factors, circuit voltages, shipping information, list prices and other pertinent data.

11 **Gearmotor Handbook**—Booklet B-3218 shows how gearmotors cut power transmission losses, save installation time and expense. Includes application details and other handbook data. Westinghouse Electric & Mfg. Co.

12 **Dry-Type Transformer**—Bulletin B6027 shows how the Allis-Chalmers AD dry-type transformer, installed at load center, steps up motor and lighting performance. These transformers are small, light, won't drip, go up anywhere. Allis-Chalmers.

FANS, PUMPS, COMPRESSORS

13 **Centrifugal Pumps**—Bulletin 300 describes a complete line of centrifugal pumps, available in bronze fitted, all iron or special metal construction for handling corrosive liquids, 38 sizes—capacities to 4500 gpm at 1500 lb pressures. American-Marsh Pumps, Inc.

14 **Practical Pumping Problems**—Handy new booklet answers such problems as: How can I reduce cavitation of pump impellers—How eliminate frequent redressings of pump shafts—How cut down power, packing and maintenance costs? The International Nickel Co.

15 **High-Pressure Pipe Line Pumping**—Bulletin tells about the new Clark BA-17 gas engine driven compressor, 1600 BHP, pumping natural gas on pipe line of the Memphis Gas Co. It is said to be most powerful unit of this type ever built. Clark Bros., Inc.

16 **Centrifugal Pump Handbook**—"Self-Priming Centrifugal Pumps," sets forth in easy-to-understand style, principles of centrifugal action, physics of pumping, evolution of self-priming centrifugal pumps. The handbook tells the difference between the types of self-priming centrifugals, points out where self-primers can be used with best effect, explains how to install and care for them. Marlow Pumps.

17 **Pump Reconversion Kit**—The "Reconversion Inventory Kit" will speed the task of determining the condition of your centrifugal pumps. Check list helps locate trouble spots and clear them up. Similar kits cover motors and V-belt drives. Allis-Chalmers Mfg. Co.

18 **Oil Lubricated Turbine Pump**—New bulletin with large sectional drawing describes solenoid oiler, inclosed impellers, automatic clutch and other features of Fairbanks-Morse turbine pumps. Includes tables of sizes and rates, other useful pump data. Fairbanks, Morse & Co.

INSTRUMENTS & CONTROLS

19 **Testing and Measuring Materials**—How the Sperry Supersonic Reflectoscope is used for the non-destructive testing and measuring of materials is explained in Bulletin 3000. Device is comparable to X-ray and magnaflux for detecting hidden flaws in castings. Sperry Products, Inc.

20 **Cut-Off Register Control**—New 8-pg. bulletin, well illustrated with photos and diagrams, shows advantages of G-E cut-off control for paper fabricating and packaging machines. Installation of electronic control of register reduces operator fatigue, increases production. General Electric Co.

21 **Thermocouple Data Book**—Wheelco Instruments Co. has issued a new edition of its Thermocouple Data Book and Catalog. Containing 32-pg. and designed Bulletin S2-6, it gives information on selection of proper thermocouples and carries installation tips. It describes and lists prices and recommendations on thermocouples, thermocouple wire, lead wire, heads, connectors, plug and socket assemblies, insulators, and protecting tubes.

22 **Dial Type Temperature Regulators**—Bulletin L tells about the operating principles and advantages of the Defender dial type temperature regulators; also gives prices and ordering instructions. Defender Instrument & Regulator Co.

23 **Refrigeration Controls Catalog**—The Taylor Instrument Companies just published a 36-pg. catalog dealing with application of control instruments to the refrigeration field. The catalog is divided conveniently into two sections, one covering applications—the other, instruments. Applications are reproduced for the purpose of showing certain processing requirements in refrigeration.

24 **Thermo-Control Fan**—Book illustrated with cartoons tells how the Evans Thermo-Control fan regulates the jacket water temperature of all types of internal combustion engines within close limits. Said to increase horsepower output, save fuel and oil. Evans Products Co.

25 **New Speed Indicator**—Bulletin describes the Lyons indicator for furnishing accurate measurements of constant machine speeds either in revolutions or feet per minute, in a few seconds time. Consists of a precise chronometric movement, with chip-proof, easy-to-read dial. Boulin Instrument Corp.

26 **Portable A-C Test Sets**—New 24-pg. bulletin, containing data and descriptive information on the complete line of portable a-c test sets from 2000 to 150,000 volts, has been announced by the General Electric Co. This well-illustrated bulletin enables the user of high-voltage testing equipment to compare the features and ratings of the various standard sets, and to select the equipment best suited to his individual requirements. The portable equipment covered in the bulletin include small insulation testers, oil testers, and larger general-purpose test sets, with ratings as high as 25 kva.

MAINTENANCE MATERIALS

27 **Silicone Compounds and Greases**—New bulletin tells how Dow Corning silicones are used as heat stable compounds for sealing aircraft engines and radar equipment; as lubricants for valves and bearings operating at extremely high and low temperatures; as heat resistant, waterproof varnishes and resins in electrical insulation. Many charts and tables. Dow Corning Corp.

28 **Leather Packings**—New folders present a useful table of standards on the correct proportions and dimensions of leather packings for almost every purpose. Table shows proper tannage and treatment of packings for various types of service. Alexander Brothers.

29 **Rust-Preventive Oils**—Well illustrated, 40-pg. booklet tells where and how to use Shell rust-preventive oils to lubricate machinery wherever moisture is a factor. Protective coatings range from thin transparent oil films to heavy, abrasion-resistant surfaces. Shell Oil Co.

30 **Pump Packing Data**—Handy reference bulletin describes the Pumcup which replaces ordinary packing on piston of a reciprocating pump or hydraulic control mechanism. Also tells about Pumcup applicatitons, fluids pumped, savings effected. Darling Valve & Mfg. Co.

Coupon must be filled in completely to secure literature your request. Pasting coupon on penny postcard saves time and money.

DECEMBER, 1945

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Your Company Name .....

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Home Address .....

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31 **Free Repair Handbook**—Company offers free protractor-rule and 40 pg guide for the use of Smooth-On cements, containing 170 diagrams and instructions for making lasting and economical repairs to plant equipment and machinery, pipe lines, fixtures, etc. Smooth-On Mfg. Co.

32 **Heat Protective Coating**—New folder describes Hytemp coating for protection against high temperatures, acids, hot fumes, corrosion; also to resist adhesion of spatter in welding and brazing. Has chromic oxide base, resists temperatures up to 3500 deg F; applied by brush, spray or dipping; used on brick, metal and graphite surfaces. Geo. R. Mowat Co.

33 **Floor Maintenance Problems**—Illustrated folder pictures 15 different problems relating to the maintanance of floors and driveways in industrial plants; suggests a specific type of Stonhard for taking care of the ruts, cracks and leaks. Stonhard Co.

34 **Lubricant Application Guide**—New 32-pg. handbook contains recommendations for lubrication of blowers, compressors, conveyors, crushers, engines, and material handling equipment. Also generators, pumps and other power service gives tips on metal protection coatings. Keystone Lubricating Co.

35 **Bulletin On Cutting Electrodes**—New bulletin on Ellpro cutting electrodes gives complete details and specifications, together with a fully illustrated description on how to use the electrodes. There is no need for pre-heating—the cutting action starts instantly in water or air by striking the arc. Ellwood Products Corp.

36 **Plant Maintenance Handbook**—New, informative 20-pg. Digest On Modern Power Plant Procedures gives tips on up-to-the-minute techniques for cleaning, de-rusting, paint stripping and other power plant maintenance tasks. Covers descaling heat exchange equipment and cooling systems, boiler room equipment; salvaging fittings, valves, pumps, etc. Oakite Products, Inc.

37 **Mineral Wool Insulations**—Baldwin-Hill Co. has issued a new 28-pg. Industrial Catalog describing in detail the various high and low temperature mineral wool insulations made by this firm. Book is fully illustrated and complete with application specifications, conductivity curves and engineering data.

PIPING, VALVES, FITTINGS

38 **Purifier For Steam and Air Lines**—Bulletin gives dimensions and specifications for Centrifix Type BL purifier installed in vertical downflow or horizontal pipe lines for the removal of all liquid and solid impurities from steam, vapor, gas or air. Takes advantage of centrifugal force; reasonably priced. Centrifix Corp.

39 **Pipe and Stud Extractor**—How Reps extractors do away with preparatory steps formerly required in backing out broken pipe, tubes, bolts, studs and screws is described in new 4-pg. bulletin. Extractor grips without hammering; pulls rather than reams. Reps Tool Co., Inc.

40 **Solenoid Valves**—Circular No. 200 describes the operating features and advantages of Asco solenoid valves for the automatic and remote control of liquids and gases. Photos show installations on engines, pumps, oil burners and other power equipment. Automatic Switch Co.

41 **Where to Use Valves, Drains and By-Passes**—Thirty-two pages of interesting information tells you which valves to use, differences among the various types of valves, the fundamentals of valve designs and application. Jenkins Bros.

42 **Seamless Flexible Metal Hose**—Bulletin H 201-935 furnishes engineers complete data covering the physical properties and other pertinent information. Generously supplied with illustrations and diagrams, it is invaluable to engineer, designer, and specification man. Eclipse Aviation Seamless Flexible Metal Hose, Philadelphia Div. of Bendix Aviation Corp.

43 **Lubricated Plug Valves**—Walworth Lubricated Plug Valve Catalog is just off the press. It shows how lapped surfaces are "pressure sealed" when valve is open or shut; gives prices, dimensions and other useful data. Walworth Co.

44 **Handbook On Spring Hangers and Vibration Eliminators**—Conclusions of prefabricated power piping engineers regarding the design of piping layouts for flexibility have been published in a booklet entitled "Blaw-Knox Functional Spring Hangers and Vibration Eliminators." Gives many details concerning standard and special types and sizes of functional spring hangers and vibration eliminators, with instructions for their installation, and engineering information which will be of help when adoption of this type of support is under consideration. Blaw-Knox Co.

45 **Steam Hook-Ups**—Service in the solution of any heating, cooling or temperature control problem is offered by experienced Sarco representatives. Send for "Steam Hook-Up" Book which gives diagrams, tables and recommendations of value to steam process and heating engineers, Sarco Co., Inc.

PRIME MOVERS & AUXILIARIES

46 **Steam Turbines For Maritime Use**—A bulletin recently issued by the Allis-Chalmers Mfg. Co. describes the company's wartime experience in producing 6000 shp cross-compounded turbines to power Victory ships. The bulletin makes use of 52 photographs and drawings to illustrate the manufacturing processes used in placing these war-rushed steam turbines on a production line basis.

47 **Dieseis In Municipal Power Stations**—New 12-pg. booklet issued by Diesel Engine Manufacturing Assn. deals with use of Diesel engines installations in municipal power stations. Includes pictures and performance data in various sizes of plants, what city officials say about Diesel power.

48 **Turbine Generators**—Moore Steam Turbine Div, Worthington Pump & Machinery Corp. 46-pg. bulletin No. 1960 covers models, applications and applications and installations of Worthington turbine generators.

49 **Diesel Electric Sets**—Advantages of "Caterpillar" diesel electric sets are discussed, and numerous installations of these sets are shown, in a new 12-pg. booklet published by Caterpillar Tractor Co. Photos show electric sets in both single and multiple installations on many jobs, and how they are applied to the requirements of carnival, creamery, crushing plant, construction and mining camps, service station and tourist court, machine shop, theatre, oilfield, ranch, telephone company and village.

50 **Shut-Down Control of Diesel Engines**—Data sheet R-18, released by Viking Instruments, Inc., announces the Viking Type R-18 Safety Control System for the Shut-Down of Diesel Engines when temperature of the circulating-water system becomes too high, or when there is insufficient lubricating oil pressure. Data Sheet contains complete information on operation, with detail drawings of general arrangements, installation and operating instructions, and ordering information.

51 **Steam Turbines**—De Laval Steam Turbine Co. 24-pg. catalog No. 1181 explains complete line of steam turbines, helical gears, centrifugal pumps, centrifugal compressors, worm-gear speed reducers and IMO oil pumps.

52 **Two-Cycle Diesel Engines**—Bulletin 122 gives operating details and shows installation photos of Norberg stationary 2 cycle Diesel engines. Sizes range from 750 to 8500 BHP. Nordberg Mfg. Co.

53 **Extraction Steam Heaters Explained**—An informative bulletin on Extraction Steam Heaters has just been prepared by The Griscom-Russell Co. It describes extraction heaters of both horizontal and vertical types, for high, medium and low pressures. Cross-section diagrams graphically explain operation as well as constructions. Also discusses the G-R exclusive visible pressure seal of breech-block heads, self-adjusting compression ring gaskets.

WATER TREATMENT

54 **Advantages of De-Ionized Water**—How de-ionized water replaces distilled water at much lower cost is described in bulletin issued by Illinois Water Treatment Co. With flow rates up to 500,000 gal. per hr., Illco-Way De-ionizing units are used in many industrial and chemical plants.

55 **Chemical Feed Systems**—"What The Power Engineer Needs To Know about Chemical Feed Systems for Water Treatment" is the subect of an 8-pg. bulletin. Gives useful data on volumetric, gravimetric, decanting feeders; contains many performance charts. Milton Roy Pumps.

56 **Liquid Filters**—How Staynew filters remove sediment from drinking or process water, oil and grease from condensate, sludge from quenching oils, dirt from fuel oils, etc., is explained in new bulletin. Staynew Filter Corp.

57 **Cochrane Demineralizers**—The process of preparing clear water, the equivalent of commercially distilled, by ion exchange is described in Cochrane Corporation's new Bulletin 4181—"Cochrane DeMineralizers." This new and revolutionary method of preparing clear water for process offers opportunities of economies and improved products wherever there is a need for mineral-free water.

58 **Controlling Corrosion By Deaeration**—A restatement of the science of deaeration and its effectiveness in controlling corrosion is the major part of a 20-pg. booklet just issued by the Elliott Co. Illustrated with charts and photographs, the booklet describes corrosion in general and the part which deaeration plays in checking it. Including in the text is a table showing the derivation of the pH factor and a graph indicating the effect of pH on the rate of corrosion.

59 **Recirculating Cooling Water Studies**—Designated as Betz Technical Paper No. 102, "Once Through and Recirculating Cooling Water Studies," discusses results obtained in scale prevention in cooling water systems using various chemicals under various conditions. The effect of calcium content, cycles of concentration, temperature, treatment, etc. are evaluated. Numerous photomicrographs illustrate the effect of these variables on the scale crystals formed. W. H. & L. D. Betz.

MISCELLANEOUS

60 **Accident Prevention Equipment**—New 128-pg. catalog and handbook describes safety belts, danger signs, fuse pullers, ladder shoes, goggles, welding helmets, and other safety equipment items for all industries. Has convenient index. Industrial Products Co.

61 **Heat Recovery Silencers**—Bulletin WH-101 shows various types of heat recovery silencers and practical hookups for putting exhaust heat to work. The Maxim Silencer Co.

62 **Insulating Varnish Selector**—Handy, easy to use selector gives all the facts on 7 insulating varnishes—characteristics, applications, baking and drying time, base, thinner, and viscosity. Gives tips on treating coils, general repair work. General Electric Co.

63 **Revolving Unit Heaters**—Bulletin H R-4 furnishes complete design, construction, engineering data and installation planning on the Wing line of revolving unit heaters. L. J. Wing Mfg. Co.

64 **Oil and Heat Resistant Rubber**—A new edition of its catalog section on the properties of Ameripol D, an oil and heat resistant synthetic rubber which it developed for specialized applications, has just been published by The B. F. Goodrich Co.

65 **Tips On Low Temperature Welding**—The Eutectic Welding Alloys Co. has recently issued a 4-pg. bulletin entitled "Production Ideas." It gives a complete discussion of the Eutectic Low Temperature Welding Process and its complete assortment of specially developed rods and fluxes. Many photographs and technical diagrams illustrate the jobs that will be done in the post-war period. There is also a listing of the forty-seven eutectic welding alloys and how they can be applied in the various fields of production.

66 **Speeding Diesel Engine Overhaul**—"How Surface Chemistry Can Speed Up and Simplify Diesel Engine Overhaul" a new, handsomely illustrated, fact-filled booklet, is offered by Turco Products, Inc. Fast, simple methods of removing carbon, grease, oil, asphalt and tar, are described. A procedure is outlined for cleaning and descaling the cooling system. A setup for salvaging parts from wrecked equipment is explained.

67 **Friction Sawing Handbook**—The new technique for cutting materials known as "Friction Sawing" recently developed through the innovation of high speed sawing machines is now described in a new 24-pg. booklet issued by the Machine Tool Division of the DoALL Co. Booklet explains why "Friction Sawing" is possible; its advantages and its limitations.

68 **Economy In Air Conditioning**—A new data folder by the W. B. Connor Engineering Corp. contains an interesting case history of the application of Dorex air recovery equipment to an existing system. With facts, figures and installation drawings, Merle Bennett, Chief Engineer of the Detroit Bank Building, tells how fuel, energy and equipment were saved. This standard file size folder also contains data on ventilation requirements and a typical cost comparison chart showing the savings in money, material and equipment on a new installation.

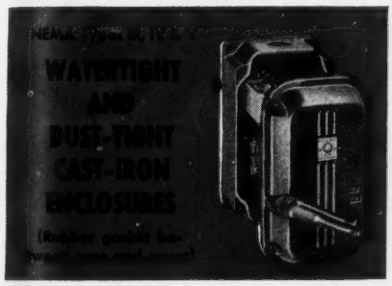
69 **Catalog Of Engineering Publications**—A 72-pg. catalogue of the publications and patents which have resulted from fifteen years of fundamental and applied Battelle research has just been published by Battelle Memorial Institute. The catalogue includes subjects in the fields of organic chemistry, electrochemistry, chemical engineering, graphic arts, welding technology, applied mechanics, mineral dressing, industrial physics, ceramics, fuels, and metallurgy.

Pick this enclosure... ..for this manual motor starting job

....get these Westinghouse Starter features!

General-Purpose Indoor Applications —normal atmospheric conditions

"DE-ION" MOTOR WATCHMAN 10-100-S



Outdoor applications including:
- Docks
- Canal locks
- Subways
- Tunnels

Indoor applications including:
- Dairies
- Breweries
- Steel mills
- Cement mills
- Woodworking plants

"DE-ION" MOTOR WATCHMAN 10-100-W

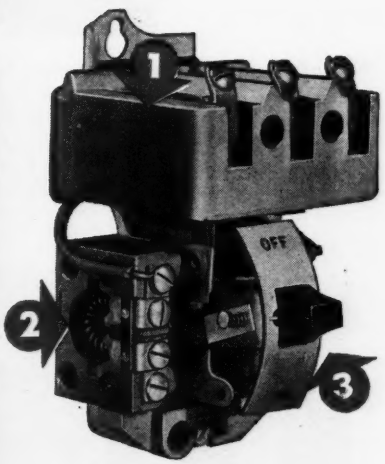
- Refineries
- Distilleries
- Varnish plants
- Flour mills
- Grain elevators
- Sugar, cocoa, coal pulverizing plants
- Aluminum and magnesium processing plants

"DE-ION" MOTOR WATCHMAN 10-100-U

Same applications as standard sheet steel enclosures—where flush mounting is desired.

"DE-ION" MOTOR WATCHMAN 10-100-P

1. **"De-ion" Arc Quenchers.** Arcs go out *quick*, making contacts last longer.
2. **Bi-Metal Overload Relay.** Accurate calibration for life of starter. Permits harmless overloads—protects motor against dangerous running overloads or stalled rotor conditions.
3. **Quick-Make, Quick-Break Action.** Prevents teasing, prolongs contact life.



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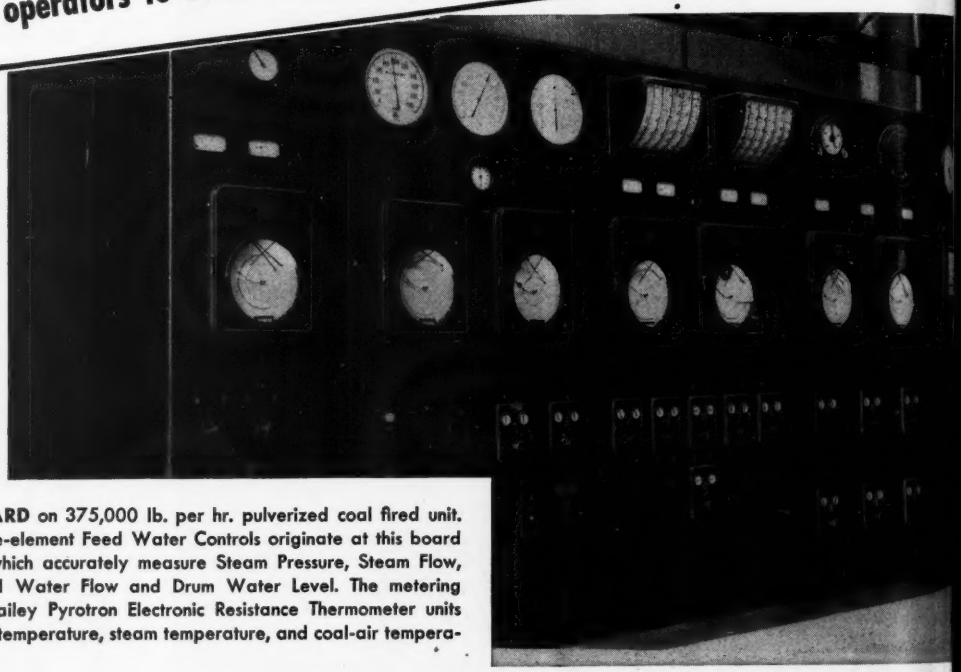
J-60614

Westinghouse MOTOR CONTROL

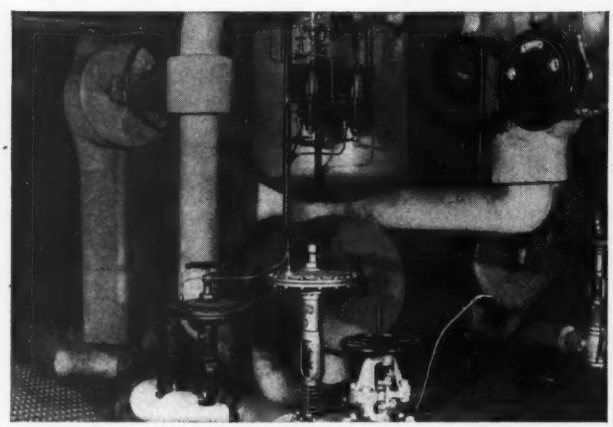
PLANTS IN 25 CITIES... OFFICES EVERYWHERE

Dedicated to Optimum Steam Plant Performance

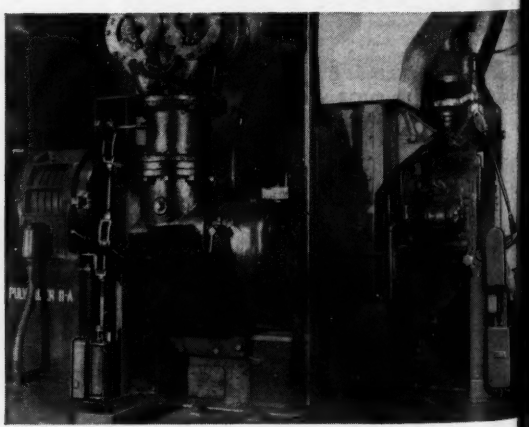
Bailey Controls at Williamsburg Station of Pennsylvania Edison Co. help operators to secure Safety, Economy and Continuity of Service



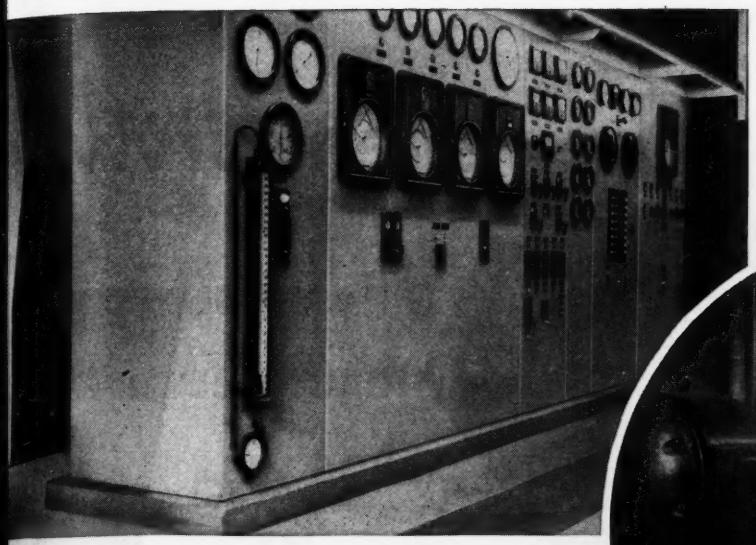
BAILEY BOILER BOARD on 375,000 lb. per hr. pulverized coal fired unit. Combustion and Three-element Feed Water Controls originate at this board from Bailey Meters which accurately measure Steam Pressure, Steam Flow, Air Flow, Draft, Feed Water Flow and Drum Water Level. The metering equipment includes Bailey Pyrotron Electronic Resistance Thermometer units to record feed water temperature, steam temperature, and coal-air temperature at each mill.



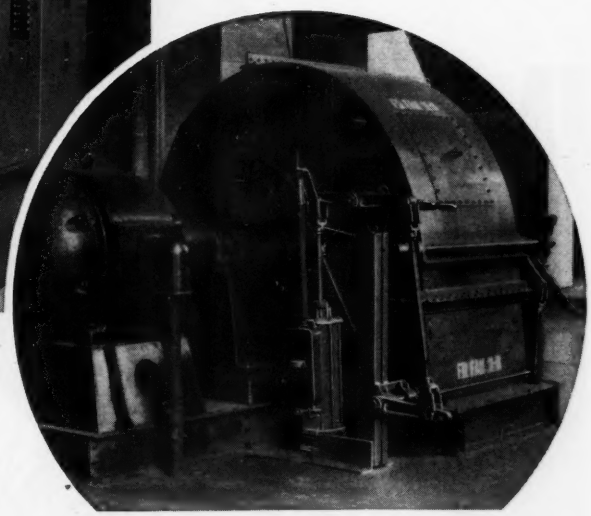
HEATER DRAIN CONTROL. Bailey Level Controller and relays regulate drain valves to maintain the desired high pressure drainer level.



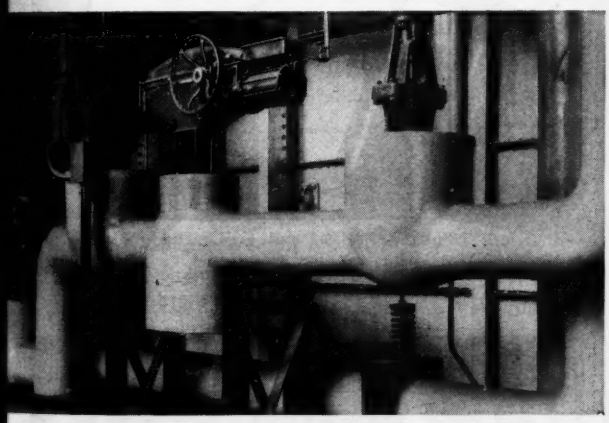
PULVERIZER CONTROL. These Bailey Control Drives regulate raw coal feed and coal-air output from a Riley Atrita Pulverizer in accordance with boiler load demand as measured by the Bailey Master Steam Pressure Controller.



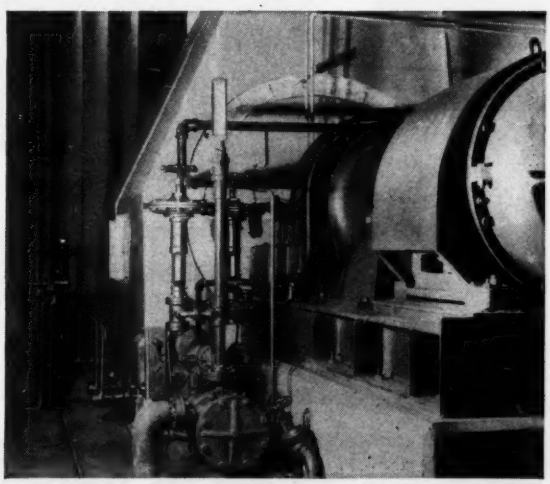
TURBINE BOARD. A Bailey Three-element System of condensate control originates at this board from the first three recording meters which measure: (1) Total flow output from high pressure boiler feed pumps, (2) Condensate flow to No. 1 Heater, (3) Level in No. 3 Heater. The fourth meter records and integrates steam flow to the high pressure turbine and a fifth meter records pressure and temperature of desuperheated steam.



FORCED DRAFT FAN CONTROL. Bailey Control Drives position inlet vanes to supply air for combustion in accordance with the requirements established by the Master Steam Pressure Controller and the Bailey Boiler Meter.



BAILEY THREE-ELEMENT FEED WATER CONTROL VALVE. This powerful valve regulates feed water input to the boiler so that it equals steam output and maintains a safe drum level at all times. Control impulses originate from the accurate measurements of Bailey Meters on the Boiler Board.



INDUCED DRAFT FAN CONTROL. Bailey Control Drive and Valves regulate the induced draft damper and the hydraulic coupling fan speed control to maintain the desired furnace draft.

All photos by the courtesy of Burns & Roe, Inc. For more information on coordinated Boiler Control Systems, such as installed at the Williamsburg Station, ask for Bulletin 15-C.

A-96

BAILEY METER COMPANY

1040 IVANHOE ROAD • • • CLEVELAND 10, OHIO

COMBUSTION • PRESSURE
FEED WATER • LIQUID LEVEL
TEMPERATURE • FEED PUMPS

Controls for Steam Plants

They even survive

Lowering completely assembled B&W boiler into car of 1000 kw. moLile power plant for assembly prior to shipment abroad. Boiler design is the popular B&W Integral-Furnace Boiler.

One of the 47 three-car, 1000-kw power trains built by General Electric and Westinghouse, and equipped with B&W boilers designed to burn peat, lignite, low-grade coal, and wood.

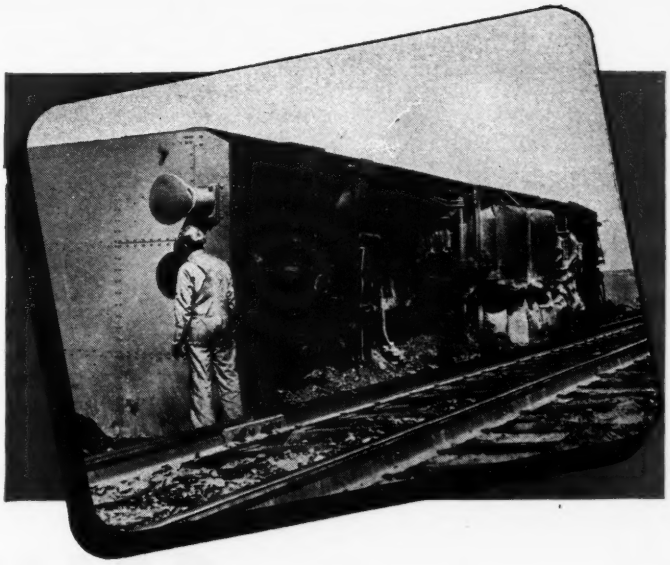
Furnace construction of B&W boilers Used in mobile power plants. Neither sidewall tile, baffling, or front brickwork suffered cracks or other damage in derailed boiler car.

Firing end of power car boiler, showing locomotive-type overfeed stoker. Normal steam capacity of boilers is 16,000 lb. per hour at 420 psi, and 730 F.

B&W also designed and built the first and largest mobile power plants. They are 140,000 lb. per hour for six-car 10,000-kw. power trains for emergency use in American war production plants.

wrecks...

UNSCHEDULED "TEST" PROVES STURDINESS OF B&W BOILERS



AN ill wind, in the form of a railroad accident, recently produced spectacular evidence of B&W boiler sturdiness, in a "test" as convincing as any ever devised by our own test engineers.

En route to Russia coupled in a freight train, the boiler car of a 1000-kw mobile power plant was derailed, dragged for a considerable distance, and turned on its side clear of the tracks.

Instead of being severely damaged as might be expected, when returned to the plant for inspection the boiler withstood the hydrostatic test pressure of 625 psi without a leak. The furnace absorbed the jolt without damage. Neither sidewall tile, baffling, or front wall brickwork suffered a crack. Damage was confined to ash-pans and pipe connections under the car. The boiler survived its fall, stood up to every test—was soon on its way to its job of supplying steam power to devastated areas abroad!

At your disposal, on any problem involving steam generation or heat transfer equipment are the B&W engineers and facilities whose products withstand such tests—the same organization that, for over 60 years, has led the trend in boiler design and workmanship: B&W designed and developed the first successful water-tube boiler; pioneered in the welding of boiler drums and in X-ray inspection of welds; has led in the development of high-pressure boilers, in conducting research in the creep of steel, and in developing improvements in equipment for producing clean, dry steam. B&W introduced the integral water-cooled furnace boiler, the Radiant, and Open-Pass boilers, and has pioneered in many other developments that have set today's boiler standards.

B&W

Water-Tube Boilers, for Stationary Power Plants, for Marine Service . . . Water-Cooled Furnaces . . . Superheaters . . . Economizers . . . Air Heaters . . . Pulverized-Coal Equipment . . . Chain-Grate Stokers . . . Oil, Gas and Multifuel Burners . . . Seamless and Welded Tubes and Pipe . . . Refractories . . . Process Equipment.

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THE BABCOCK & WILCOX CO.
85 LIBERTY STREET, NEW YORK 6, N.Y.

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CALIBRATION

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your

list

of

troubles

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HALL
BUROMIN
CALGON

HAGAN

by using the HAGAN DIFFERENTIAL MASTER METHOD OF AUTOMATIC COMBUSTION CONTROL

Any standard system of automatic combustion control will operate satisfactorily with a given set of operating conditions.

But, *continuous operation usually results in a different story.*

Coal may be coming from different sources, with varying Btu content. Fuel feeding may be erratic because of variations in coal size or moisture content. Different combinations of pulverizers may be used.

If oil is fired, it may become necessary to use low-grade fuel. The burner orifices may become clogged, or possibly worn by abrasive matter.

When the air supply is controlled by a direct measure of the rate of fuel supply, such conditions result in inefficient combustion. At best, they require more or less frequent recalibration of the fuel control—and this is possible only when the extent and duration of the change is known. Manual corrections are usually impossible and always unsatisfactory, when changes are unpredictable and erratic.

The Hagan Differential Master Method of automatic combustion control completely eliminates these problems. With this system the steam header Master Sender maintains heat input always equal to load demand, and the *Differential* Master Sender utilizes the boiler itself as a calorimeter of heat input to control air flow.

No change in calibration is required. Excess air is automatically maintained at the desired amount, and this is done in a positive and direct manner—not as an after-correction.

The Differential Master method has, during the past three years, been applied to boilers burning oil, gas, and pulverized coal. Boiler sizes have ranged from 30,000 lbs./hr. at 200 p.s.i. to 650,000 lbs./hr. at 1800 p.s.i. In every instance results have been entirely satisfactory.

We will be glad to supply full information.

HAGAN CORPORATION, Hagan Building, Pittsburgh 30, Pa.

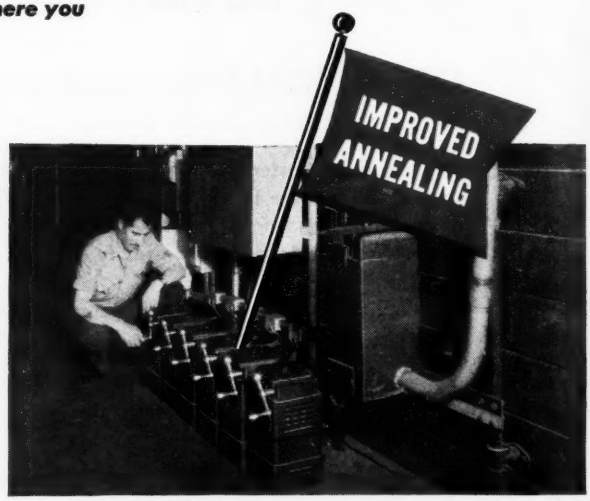
Automatic **COMBUSTION CONTROL**

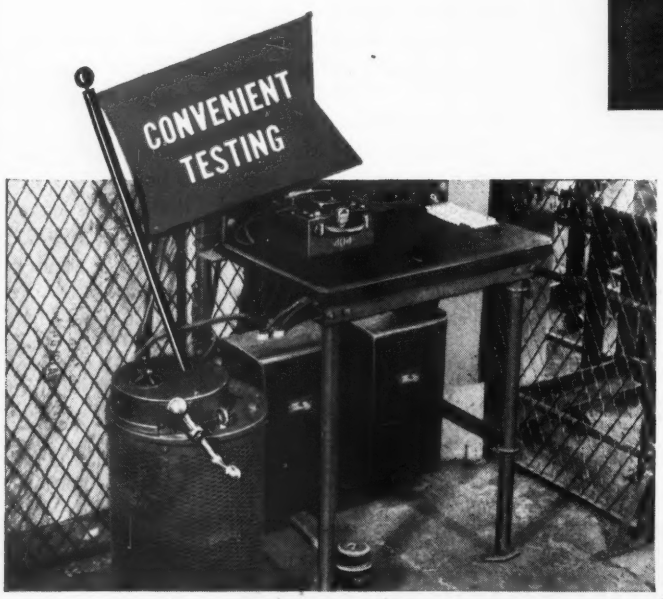
The pioneer . . . and still the leader

It's surprising how many places there are around a factory where *close voltage regulation* can improve processes or working conditions. All five regulator installations shown here, for example, are paying their way at one typical plant—probably similar to yours in many of its operations.

In planning more efficient electrical usage, be sure the right voltage is *right where you want it*. General Electric's full line of feeder voltage regulators—large and small—manual and automatic—can meet any problem where volts or kilovolts must "toe the line". And your local G-E office can deliver whatever technical aid you need to apply them to the job. *Apparatus Dept., General Electric Co., Schenectady 5, N. Y.*

1 These dry-type induction voltage regulators are used to control temperature of a wire-annealing operation. Twelve strands are processed simultaneously, each regulator acting to control the current-flow through series-connected sections of two conductors. These hand-operated regulators make it easy to adjust for different conductor sizes and other changes in operating conditions.



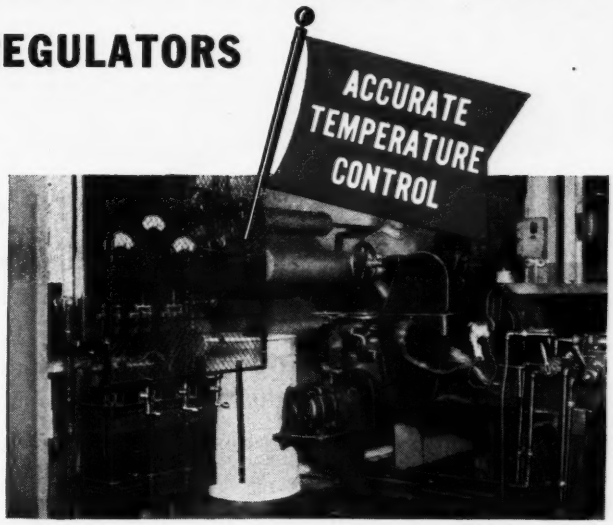


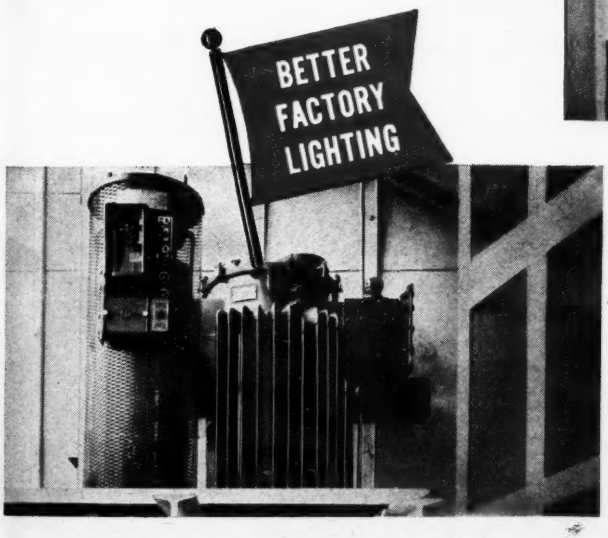
2 Smooth, stepless voltage control for 100,000-volt testing equipment is provided by this 5-kva dry-type induction voltage regulator. Connected in the primary (low-voltage) side of the step-up transformer, this regulator affords 100 per cent raise-and-lower regulation, so that output test voltage can be varied from 0 to 100 kv, simply by turning the crank.

...PAYS OFF 5 WAYS AT A SINGLE PLANT

USING G-E VOLTAGE REGULATORS

3 Electric heating circuits on a hot-rolling press used to fabricate laminated plastic forms are maintained at the required temperature with induction voltage regulators. Circuits for two electrically heated rollers and one hot plate are separately controlled by the hand-operated regulators, giving close control of processing.

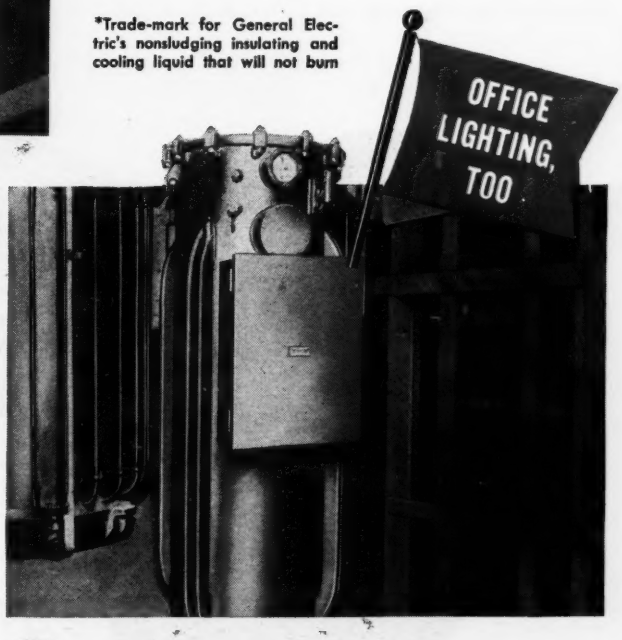




4 Automatic voltage regulation by means of this dry-type induction regulator has "paid off" in a more uniform level of illumination. The full visual value of every kw-hr is obtained with fewer lamp burn-outs from overvoltage. Production space is saved by locating the regulator on a platform along with the Pyranol* transformer which serves the lighting circuits.

*Trade-mark for General Electric's nonsludging insulating and cooling liquid that will not burn

5 This 48-kva Pyranol induction voltage regulator, installed in a basement substation, automatically maintains the proper voltage for lighting circuits in the plant office building. A Pyranol regulator was chosen for its safety in this confined indoor location.



For complete information on any of General Electric's voltage regulation equipment, write for the following publications:

Oil-immersed Induction Voltage Regulators—Type IRS
GEA-2018 (24 kva and smaller)
GEA-2985 (36 kva and larger)
Pyranol Induction Voltage Regulators—Type IRS, GEA-3443
Dry-type Induction Voltage Regulators—Type AIRS, GEA-3057
Inductrols (Small Dry-type Induction Voltage Regulators)
GEP-238
Automatic Voltage Stabilizers GEA-3634
Variable-voltage Autotransformers GEA-3635

GENERAL ELECTRIC

404-38-5400

THE ALCO FUEL

for high efficiency and economy in

An Extended-Surface Heat Exchanger

Reconversion to peace is under way, and this new ALCO standardized product is a head start to conversion for industrial oil-burner installations.

The heavier-grade and less-expensive oils require preheating for proper atomization and efficient combustion.

Now offered for IMMEDIATE SHIPMENT FROM STOCK, this Alco Fuel Oil Heater offers these important features:

1. HIGH HEAT TRANSFER DUE TO:

Superior baffle design and arrangement.

2. SIMPLICITY OF DESIGN:

A single U tube expanded into removable cover plate.

4. STANDARD SIZES AND LENGTHS:

Six sizes of standard units provided. High-efficiency heat exchangers of any capacity can be built up from these standard ALCO "X-Fin" units.

3. EASY TO CLEAN:

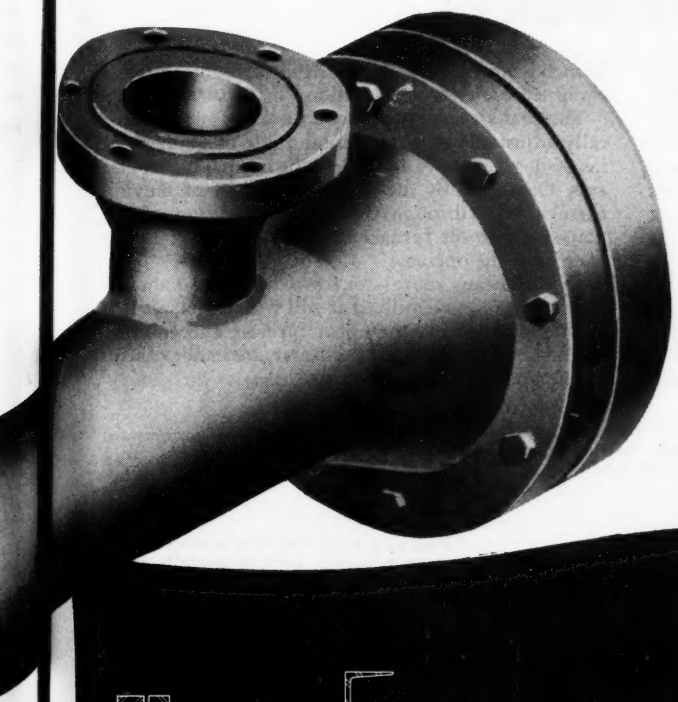
Baffle assembly easily separable from heat-transfer element.

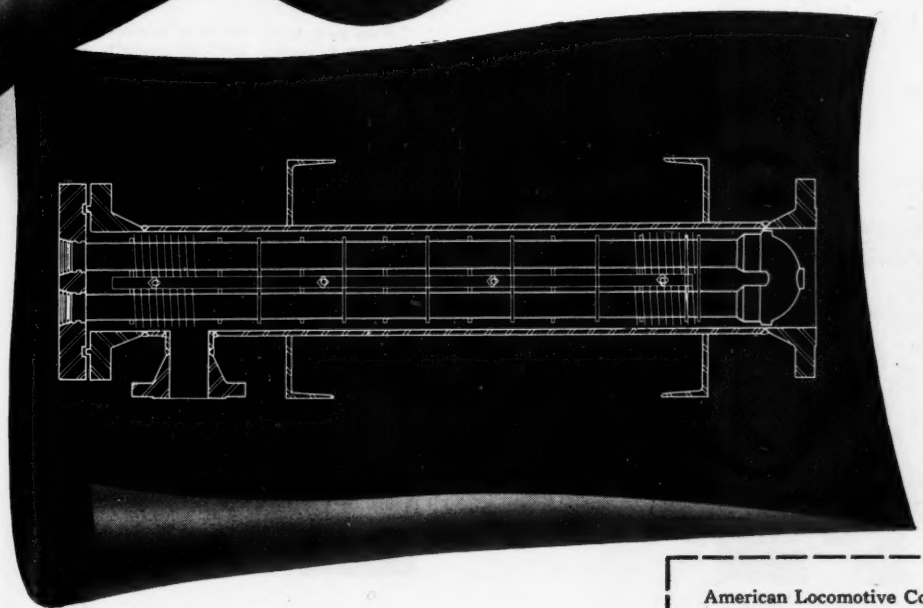
HUNDREDS USED DURING THE WAR, in a wide range of applications besides fuel-oil heating. Here are a few of many suitable applications:

1. Pre-heaters for oil refineries, natural-gasoline plants, chemical plants. 2. Residuum exchangers. 3. Solvent plants. 4. Gas and air heaters. 5. Heaters for caustics, acids, alcohols and other chemicals. 6. Kerosene and gasoline heaters; propane vaporizers and superheaters. 7. Lube-oil coolers. 8. Quench-oil coolers. 9. Duo-Sol coolers. 10. Coolers for alkylation plants. 11. Gasoline and kerosene coolers. 12. Coolers for absorption processes. 13. Gas and air coolers. 14. Compressed-air aftercoolers.

L OIL HEATER

my in space...weight...cost...and maintenance





OTHER ALCO PRODUCTS:

Oil-Tank Suction Heaters · Feed-Water Heaters

Evaporators · Reboilers

Air-Cooled Heat Exchangers · Lube-Oil Coolers

Jacket Water Coolers · Vapor Heat Exchangers

Vapor Condensers · Waste-Heat Boilers

Prefabricated Piping · Electric-Welded Steel Pipe

Pressure Vessels · Pipe-Line Filters

Weldments

Write for New Bulletin

A copy of the new ALCO Bulletin, No. 1036, describing and illustrating this new line of ALCO products will be sent you promptly, on request. Write for it today.

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ALCO PRODUCTS DIVISION

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American Locomotive Company
Alco Products Division (8)
30 Church Street, New York 8, N. Y.

Please send me your new bulletin #1036, about the Alco Fuel Oil Heater.

Name.....

Title.....

Company.....

Street.....

City and State.....

MORE ABOUT THE

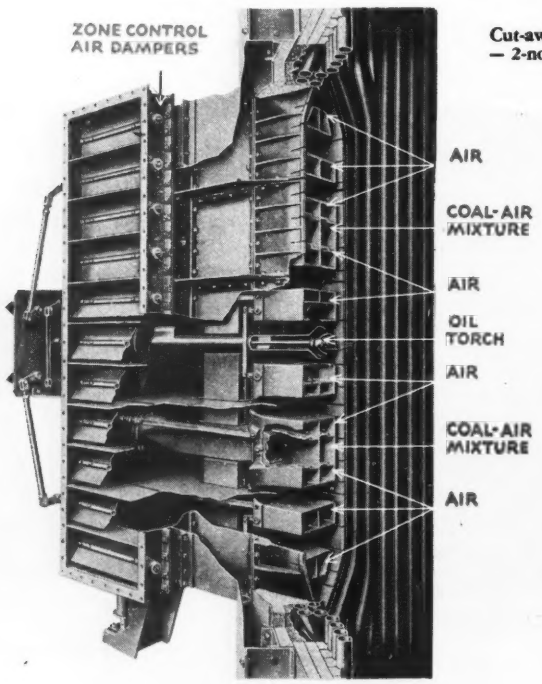
HOW IT WORKS

The key to the *adjustable furnace* is the C-E Vertically Adjustable Tangential Burner which, while somewhat complex in appearance, is quite simple in its method of operation.

The particular burner illustrated below has two pulverized coal nozzles, each of which has integral, secondary-air outlets above and below the coal-air mixture outlets in the center of the nozzle. In addition, each coal nozzle has its supplementary air nozzles above and below it. All of these nozzles are vertically adjustable by means of actuating levers which are brought out to a master operating lever outside the burner. The position of the burners is under remote control from a centrally located panel board. Each burner is provided with a built-in oil lighting torch equipped for electrical ignition.

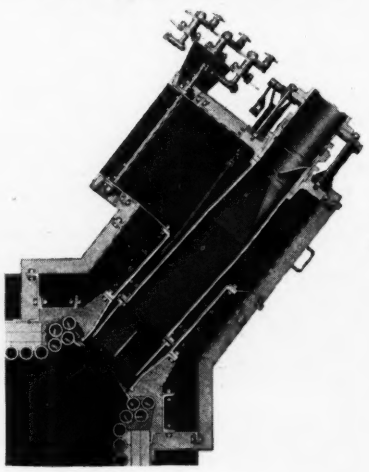
The coal-air and secondary air nozzles are all vertically adjustable through a total angle of 60 degrees, i.e. 30 degrees above and below the normal horizontal axis. Obviously by the simple expedient of moving these nozzles through this arc the position of the flame body in the furnace is brought under complete control of the operator.

By this means, more — or less — of the heat absorbing surfaces can be utilized at will with the result that gas temperatures in the upper furnace, and entering the first boiler pass and superheater, are under control of the operator.

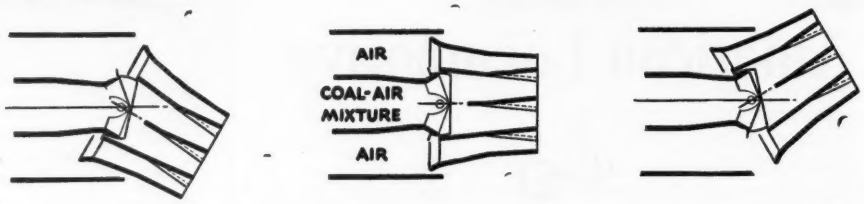


Cut-away view of Adjustable Tangential Burner — 2-nozzle type.

Plan view at one corner of furnace. Burner in each corner fires tangentially to an imaginary circle in the center of the furnace, creating maximum turbulence.



Diagrams showing how coal nozzles may be tilted to control position of flame body in furnace.



Adjustable FURNACE

WHAT IT DOES

Combustion Engineering's "Vertically Adjustable Tangential Burners", functioning as described on the opposite page achieve two very important operating advantages:

(1) primary, wide range control of superheat temperature

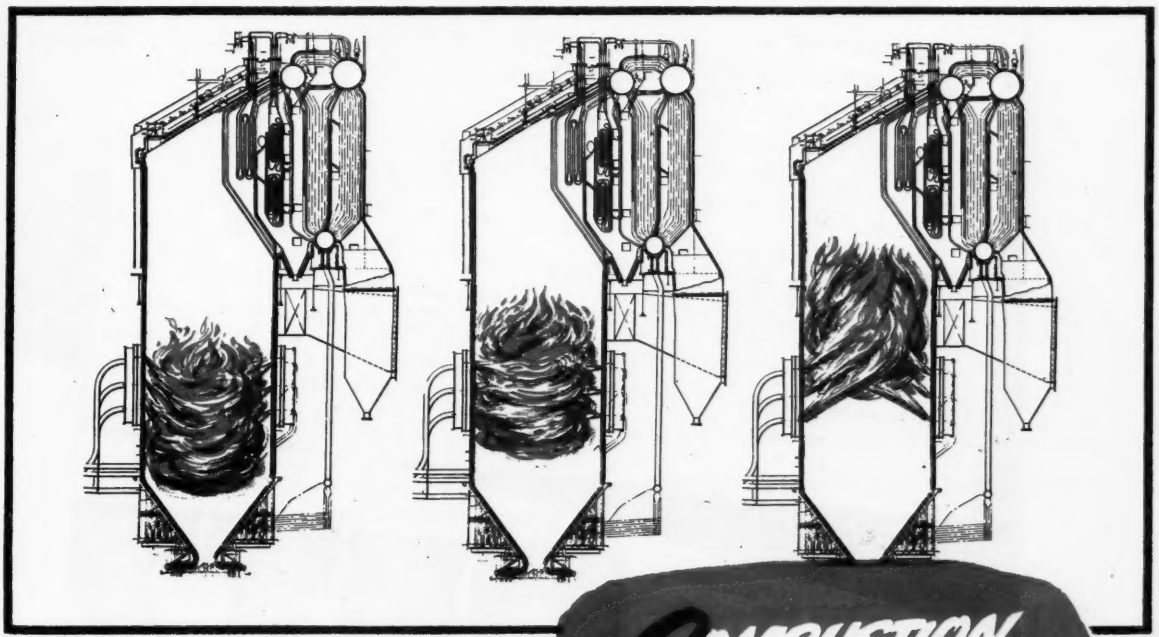
(2) substantial control over slagging conditions

These advantages are obtainable regardless of coal quality or load variation.

The illustrations on this page show how the operator can raise or lower the flame body over a considerable distance to make selective use of more or less furnace heat absorption surface and thereby effect wide range control over the gas temperatures leaving the furnace. Test results in one installation have shown that with the burner nozzles tilted from −24 to +24 degrees, the variation obtainable in gas temperatures at the top of the furnace ranges from 215 F at half load to 165 F at full load.

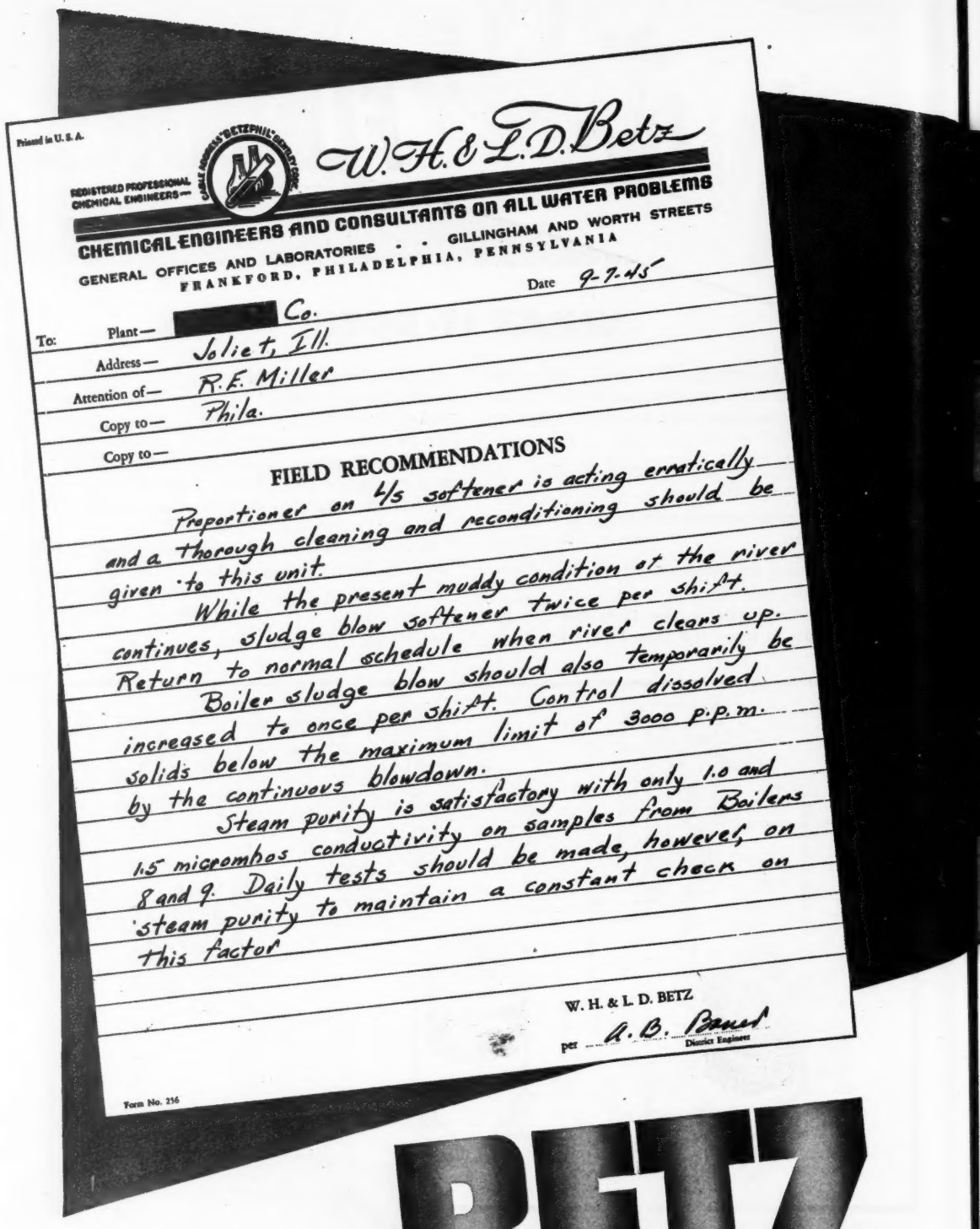
Since Vertically Adjustable Burners enable the operator to control furnace heat absorption just as though he were able to increase or decrease the size of the furnace at will, they provide, in effect, an "adjustable furnace."

A-924



COMBUSTION ENGINEERING

200 *Madison Avenue, New York* 16, *New York*



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REGISTERED PROFESSIONAL CHEMICAL ENGINEERS—

W. H. & L. D. Betz

CHEMICAL ENGINEERS AND CONSULTANTS ON ALL WATER PROBLEMS

GENERAL OFFICES AND LABORATORIES . . GILLINGHAM AND WORTH STREETS
FRANKFORD, PHILADELPHIA, PENNSYLVANIA

Date 9-7-45

To: Plant— [redacted] Co.
Address— Joliet, Ill.
Attention of— R.E. Miller
Copy to— Phila.
Copy to—

FIELD RECOMMENDATIONS

Proportioner on 4/s softener is acting erratically and a thorough cleaning and reconditioning should be given to this unit.

While the present muddy condition of the river continues, sludge blow softener twice per shift. Return to normal schedule when river cleans up.

Boiler sludge blow should also temporarily be increased to once per shift. Control dissolved solids below the maximum limit of 3000 p.p.m. by the continuous blowdown.

Steam purity is satisfactory with only 1.0 and 1.5 micrombos conductivity on samples from Boilers 8 and 9. Daily tests should be made, however, on steam purity to maintain a constant check on this factor

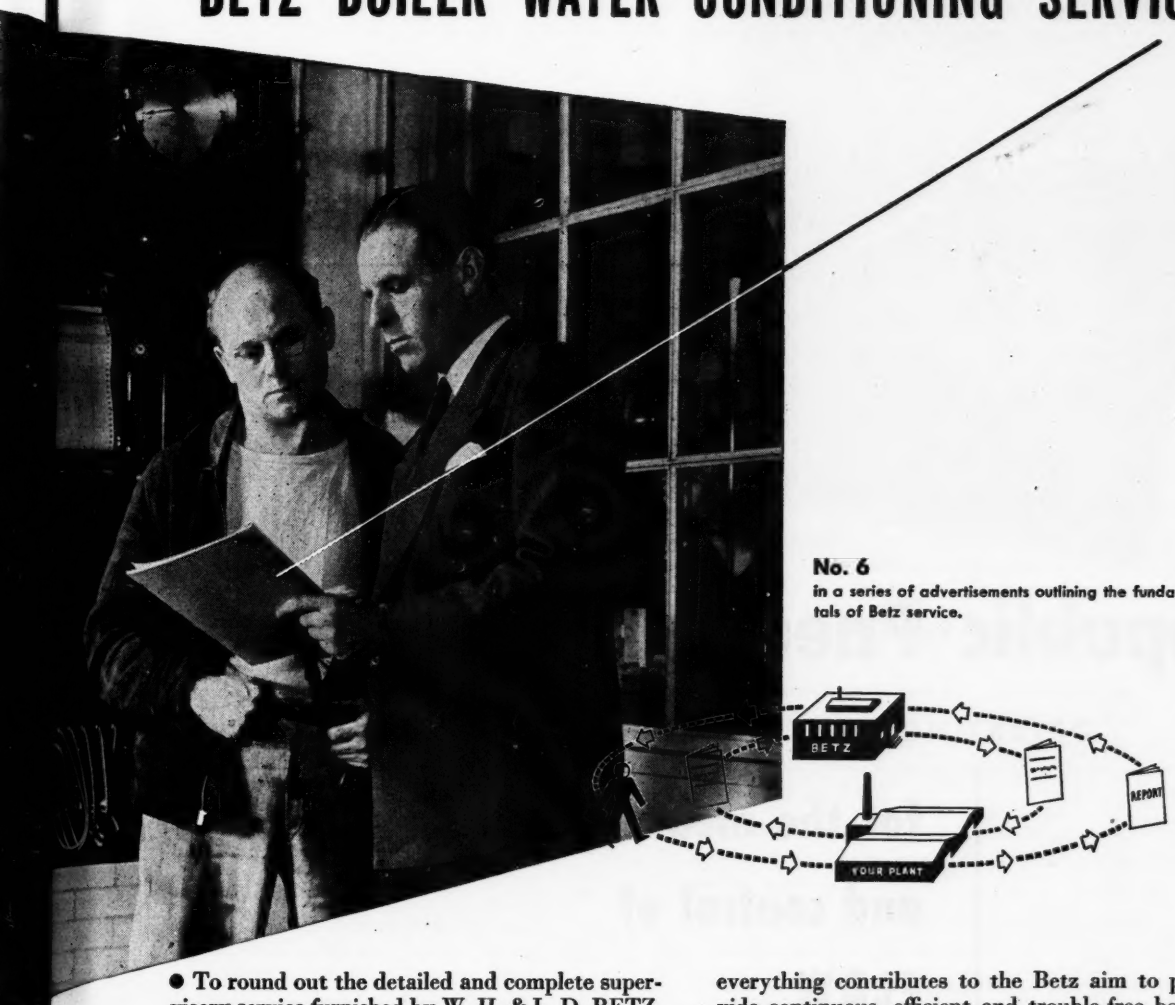
W. H. & L. D. BETZ
per A. B. Betz
District Engineer

Form No. 216

BETZ

CHEMICAL ENGINEERS—CONSULTANTS ON ALL WATER PROBLEMS

HOW FIELD RECOMMENDATIONS ROUND OUT BETZ BOILER WATER CONDITIONING SERVICE



No. 6
in a series of advertisements outlining the fundamentals of Betz service.

● To round out the detailed and complete supervisory service furnished by W. H. & L. D. BETZ, periodic visits by a chemical engineer residing in the area are made to the plant. These frequent check-up visits provide for a review of operating conditions and an opportunity for personal discussion and evaluation of any water problems which may have developed. Quite often, "on-the-spot" recommendations for minor changes in plant control are made, such as the one shown on the facing page. Whenever possible, these visits are scheduled to coincide with those of the insurance carrier inspector, so that co-inspection of internal conditions can be made.

Betz Boiler Water Conditioning Service is as near to being complete and individualized as any such service can be made. Every step in it is an important part of the whole. From the preliminary plant investigation and report, the establishment of plant control, the daily plant tests and their review, the supplementary laboratory analyses and, finally, to the periodic check-up visits . . . everything contributes to the Betz aim to provide continuous, efficient and trouble-free boiler plant operation.

W. H. & L. D. BETZ
Gillingham & Worth Sts., Philadelphia 24, Pennsylvania

THE 6 FUNDAMENTALS OF BETZ BOILER WATER CONDITIONING SERVICE

1. Complete plant investigation and report.
2. Establishment of plant control.
3. Daily plant control tests.
4. Detailed review of plant tests and report.
5. Supplementary complete laboratory analyses.
6. **Periodic "check-up" visits.**

This New Data Book No. 1000

Contains Complete Information On

Republic Pneumatic Transmitters

OPERATING ON THE FORCE-BALANCE PRINCIPLE

for the measurement
and control of
FLOW
PRESSURE
LIQUID LEVEL
LIQUID DENSITY
DIFFERENTIAL VAPOR PRESSURE

A Copy of This 28 Page Data Book Will Be Mailed On Request

REPUBLIC FLOW METERS CORPORATION
2240 DIVERSEY PARKWAY • CHICAGO 47, ILLINOIS

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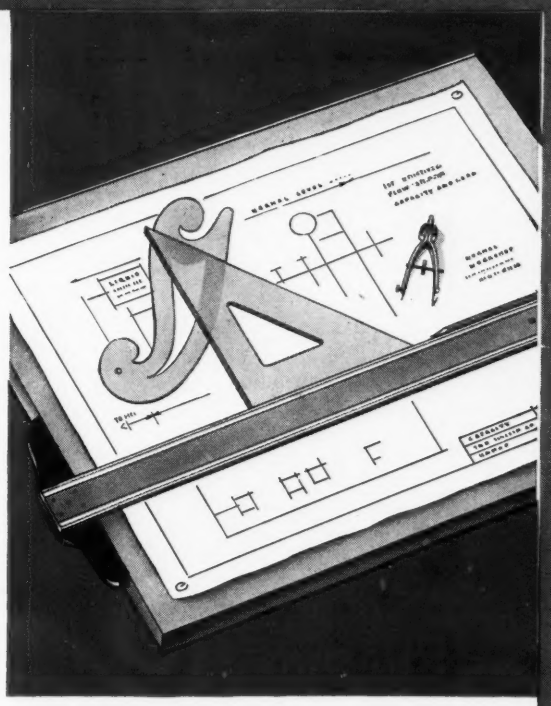
LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

Why your turbine installation plans should include



NONPAREIL
TURBINE OIL

PERHAPS you haven't thought of turbine oil as part of the turbine installation problem at this stage of your planning. But there is one oil that differs so much from other turbine oils that its use affects your plans all the way back to the drafting board. This oil—Nonpareil Turbine Oil—brings real economy in auxiliary equipment, in plant space, and in total investment.

Nonpareil Turbine Oil is *guaranteed for the life of your turbine.* That's not merely a way of saying "Nonpareil is a long-lasting oil." It means that Nonpareil should be considered as part of your turbine investment just as much as the auxiliary equipment which goes with the turbine.

HERE ARE SOME OF THE REASONS—

1. Less space is required for a turbine and its auxiliary equipment when Nonpareil is used. One fill of oil is all that is needed for each turbine. No space is needed for extra storage tanks or batch treating and settling tanks.

2. Less equipment is needed, such as pipes, fittings, pumps and tanks usually required where oil must be treated.

3. Lower operating and maintenance costs because there is less equipment to maintain.

Take time now to prove to yourself that Nonpareil Turbine Oil lives up to its written guarantee—that it eliminates turbine oil maintenance and deposits caused by oil deterioration. Test it in one or more of your present units. You'll be convinced it's the oil you want to match the efficient, generating equipment you install.

Write Standard Oil Company (Indiana), 910 South Michigan Avenue, Chicago 80, Illinois, for a Lubrication Engineer to help you make the test.

Buy and hold more Victory Bonds

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

★ LUBRICATION ENGINEERING

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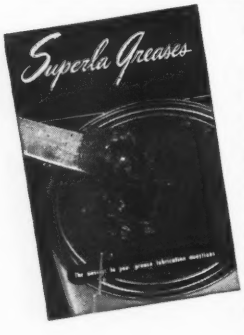
LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . .

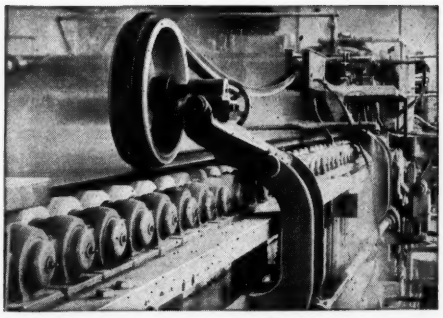
On wet, hot or dusty jobs... get better lubrication with

SUPERLA GREASES

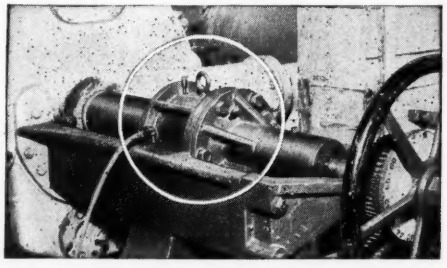
Superla Greases are available in two types and a wide range of grades. You will therefore find them the answer to better lubrication of anti-friction bearings under many operating conditions.



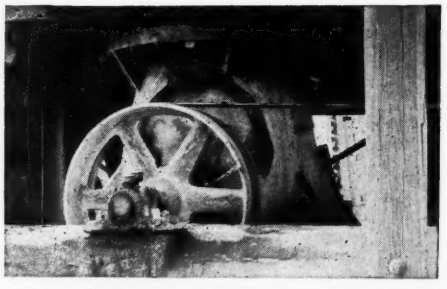
Just a few examples are briefly described here. The booklet gives more details of the properties and qualities of Superla Greases. It may help you save maintenance and money by showing you how to reduce bearing failures. Write Standard Oil Company (Indiana), 910 S. Michigan Avenue, Chicago (80), Illinois, for a free copy of the booklet.



WET Wet-end roll bearings on paper mills are particularly difficult to lubricate because they are subjected to a constant shower of water. They require a high grade moisture-resistant lubricant such as Superla Numbered Greases, which are lubricating many installations of this type.



HOT In Jordan bearings, pressures are high and excessive temperatures frequently occur. The high grade Stern Stafford anti-friction bearings pictured above have been successfully lubricated for a number of years with high temperature Superla X Grease.

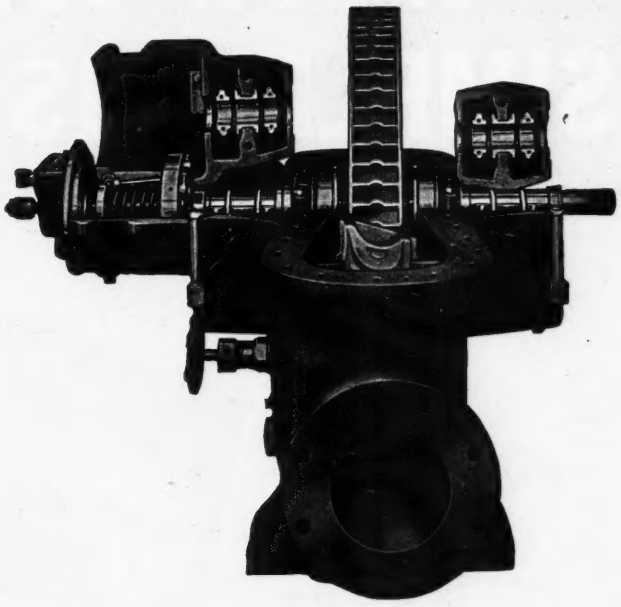


DUSTY Because all bearings can't be operated in air-conditioned surroundings, some, like the crusher bearings pictured above, need the all-weather protection of Superla Grease. Before Superla was used, these bearings twice needed replacing because of summer overheating, which allowed the grease to leak out and dust to get in. With Superla Grease, no bearings have failed, summer or winter.

Buy and hold more Victory Bonds

STANDARD OIL COMPANY (INDIANA) STANDARD SERVICE

TERRY



ROTOR AND BUCKETS ALL IN ONE PIECE

In the Terry Turbine the wheel is made from a single forging of special composition steel. The buckets are milled directly in the wheel, there are no parts to become loose or work out, such construction makes for long life and low maintenance.

This and many other features of Terry Wheel Turbine design are described in our Bulletin S-116. A request on your business letterhead will bring a copy.

T-1138

THE TERRY STEAM TURBINE COMPANY
TERRY SQUARE, HARTFORD, CONN.

ACCURATE FLOW MEASUREMENT at LOW COST

THE SIMPLEX MS METER

This low cost Simplex instrument meets the high standards for accuracy, sensitivity and dependability required in measuring flow rates in water and sewage, as well as in power and process plants.

These are some of the advantages of the Simplex MS Meter:

1. Operates efficiently with any suitable primary device.
2. Is installed and maintained economically.
3. Rugged, trouble-free construction.
4. Accuracy over entire flow range.
5. Simplex bell-shaped float which translates the half power of the differential into uniform graduations of chart and dial.
6. Direct reading totalizer of the 7 digit type.

Complete data is now available in Bulletin 350 — straight-forward, factual information with drawings, charts, and test data. Write for your copy today — specify the Simplex MS Meter in tomorrow's planning.

SIMPLEX VALVE & METER CO.
6783 UPLAND STREET, PHILADELPHIA 42, PENNA.

Greatest V-Belt Show ON EARTH!

EVERY MEMBER OF ALLIS-CHALMERS GREAT NEW V-BELT TEAM IS SPECIALLY DESIGNED, TESTED AND BUILT TO LICK A SPECIFIC DRIVE PROBLEM, SAVE YOU MONEY AND TROUBLE

DON'T WORRY IF YOUR BELTS MUST PRACTICALLY BATHE IN OIL OR GREASE. JUST ASK FOR SUPER-7 OIL-PROOF. I'M MADE OF IMPERVIOUS NEOPRENE.
OIL

Texrope V-belts are available nation-wide through Allis-Chalmers Dealers and Sales Offices. It pays to make Allis-Chalmers your V-belt drive headquarters.

ALLIS-CHALMERS

Texrope Super-7 V-Belts result from the cooperative research of two great companies—Allis-Chalmers and B. F. Goodrich—and are sold exclusively by A-C.

A 1961

BULLETIN!

SPEED RECONVERSION WITH HELP OF NEW FREE A-C KIT!

Guide to "How to Take Reconversion Inventory" of Drives, Motors, Pumps

Help in the big job of reconverting for peacetime production is now offered to plants everywhere by Allis-Chalmers Mfg. Co., its district offices and distributors. To all who request it, we're sending the new "Reconversion Inventory Kit", planned to speed the task of determining the condition of your existing equipment — V-belt drives, motors, and centrifugal pumps — which will be used in reconverted production.

SUGGESTS PROCEDURE, STATES STANDARDS

Used by foremen, maintenance men, and engineers, the Kit is a real time-saver... leads efficiently to probable trouble spots, helps clear them up. Gives bearing tolerances, resistance formulae, etc., in compact, easily-used form. Check List appraisal charts help determine present and future condition of units inventoried.

HOW TO GET YOUR KIT

For your free Reconversion Inventory Kit, call your nearest Allis-Chalmers distributor or district office, or write Dept. 98, ALLIS-CHALMERS MFG. CO. Milwaukee 1, Wis.

ALLIS-CHALMERS MFG. CO.
Dept. 98, Milwaukee 1, Wis.

Please send Reconversion Inventory Kit free of charge to:

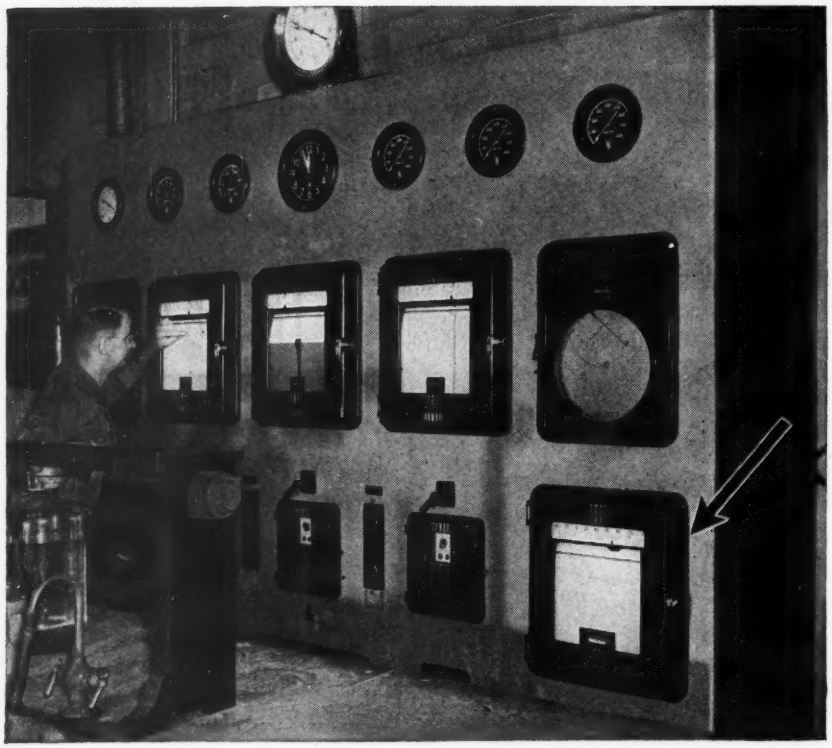
Company.....

Address.....

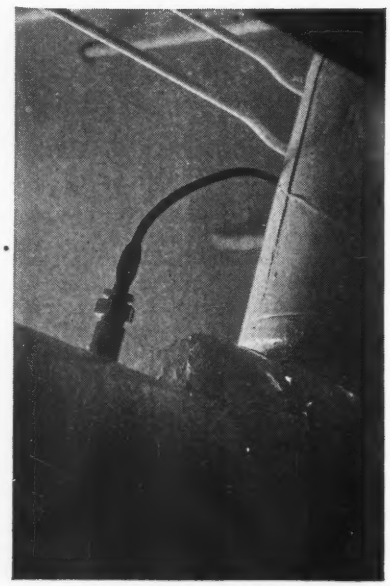
.....

Attn. of Mr.....

HEAR THE BOSTON SYMPHONY: *Saturday, American Broadcasting Co.*



Instrument panel in Deepwater Operating Co.'s Water Treating Dept., Penns Grove, N. J. Micromax Temperature Recorder (arrow) shows temperature of various water lines, thus helping prevent freeze-ups in this vital station, which not only carries a central station load, but also supplies steam to a nearby process-industry plant.



This Thermohm, mounted in its protecting well and held firmly in place by its molded bushing, translates temperature into electrical resistance and reports it to a Micromax Recorder like the one in the top picture.

"DEEPWATER" GETS PROMPT WARNING IF FREEZE-UP APPROACHES

A "freeze-up" in Deepwater's water-treating plant could be a real disaster, because this station, operating non-condensing, uses 62,500 gallons of Salem Canal water each hour of the day's 24. Naturally, with such a quantity required, storage of enough water to last any length of time presents a tremendous problem . . . so that a freeze might even cause a shutdown. It is thus inevitable that a red-letter instrument in the plant should be the Micromax Temperature Recorder, which dependably warns when and if any water line nears the freezing point.

Deepwater engineers depend on the accuracy characteristic of Micromax,—both to allow time for all possible anti-freezing precautions as temperature turns critical, and to provide for the lag in emptying pipes if that should ever become necessary. A feature for convenience is Micromax's reliable recording, on a single instrument, of Thermohms situated in pipes at varying distances from the Recorder, so that the entire temperature picture is visible at a glance.

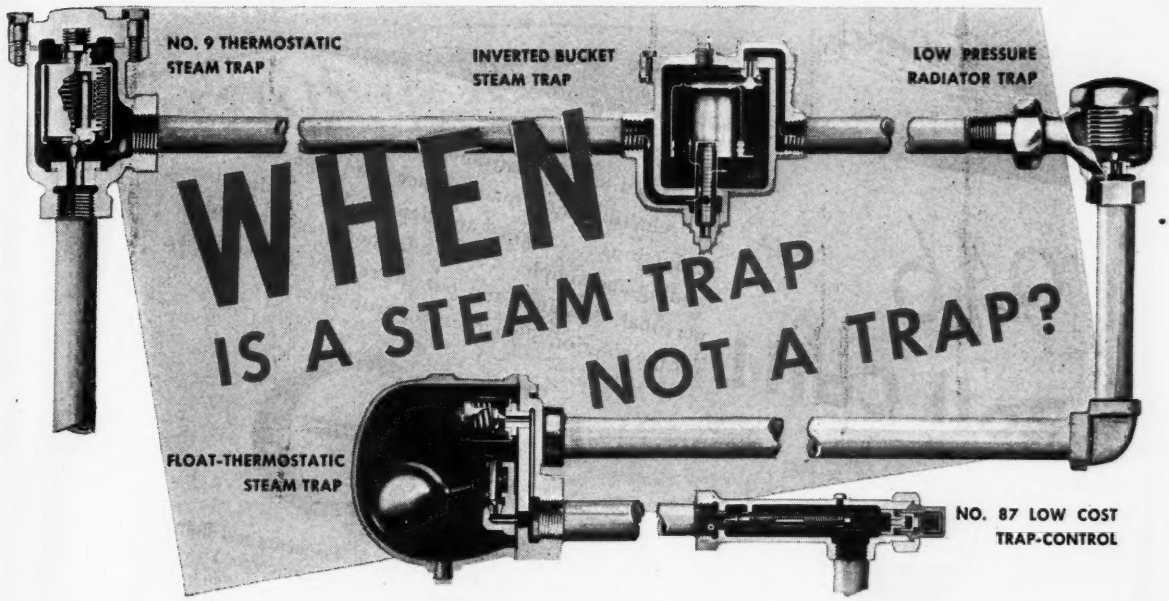
Micromax temperature recording and control covers a wide range of applications. For details or for help on a specific problem, write us; we send recommendation or appropriate catalog, as you prefer.

LEEDS & NORTHRUP COMPANY, 4973 STENTON AVE., PHILA. 44, PA.

LEEDS & NORTHRUP

MEASURING INSTRUMENTS · TELEMETERS · AUTOMATIC CONTROLS · HEAT-TREATING FURNACES

Jrl Ad N-33C(7)


NO. 9 THERMOSTATIC STEAM TRAP
INVERTED BUCKET STEAM TRAP
LOW PRESSURE RADIATOR TRAP
WHEN IS A STEAM TRAP NOT A TRAP?
FLOAT-THERMOSTATIC STEAM TRAP
NO. 87 LOW COST TRAP-CONTROL

Thousands of steam traps that look as efficient as those above are not functioning properly if at all. Even a Sarco trap if improperly selected and installed will not do what a trap should do.

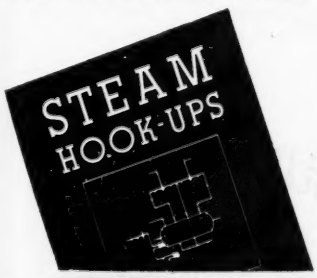
There is a simple, inexpensive solution to every steam, hot water, or cooling control problem, with some one of the many Sarco products.

NO MATTER HOW BUSY YOU ARE, the day is coming soon when your plant must be on a more efficient basis—as to fuel, metered water, out-put of machines and quality of your product. Sarco steam traps and temperature controls affect all four items. The cost for improvements is soon forgotten. Why not write us now and get started on the right track for efficient peace-time production?

Hundreds of ideas and hookups are given in the Sarco Hook-Up book and Bulletins. Ask for them.

HAVE YOU—

1. *The right kind?*
2. *The right size?*
3. *For the right pressure?*
4. *Traps of correct design and construction?*
5. *And properly hooked up?*



THIS HOOK-UP BOOK HAS THE ANSWERS

122

FOUR STARS ON OUR E PENNANT TESTIFY TO SARCO PERFORMANCE IN THE WAR EFFORT

ARMY E NAVY

SARCO SAVES STEAM

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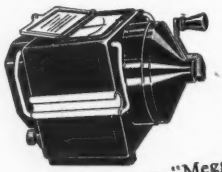
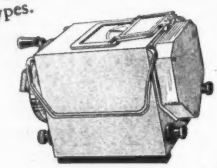
SARCO COMPANY, INC., 475 FIFTH AVE., NEW YORK 17, N.Y. • Sarco Canada, Ltd., 85 Richmond St., W., Toronto 1, Ont.

1946 Roll Call!

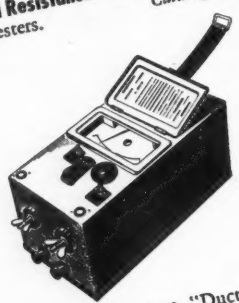
Specialized testing instruments and equipment . . . for rehabilitation, maintenance and special investigations . . . rugged and dependable . . . direct-reading and simple. . . . We offer our literature, our personal assistance and our instrument specialties for the solution of your testing problems.



For Insulation Resistance. "Megger" Insulation Testers—Hand driven, Motor driven, "Meg," "Bridge-Meg," "Super-Meg" and Midget Types. *Catalog 1685-PE*



For Ground Resistance. "Megger" and "Meg" Ground Testers. *Catalog 1645-PE*



For Conductor Resistance. "Ducter" Low Resistance Ohmmeters—down to .000001 ohm. *Bulletin 1635-PE*

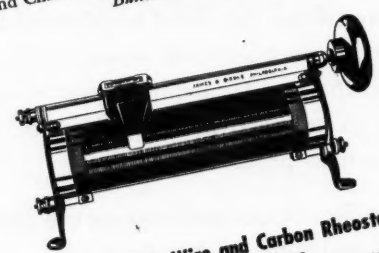
"Megger" Ohmmeters—up to 1000 megohms. *Bulletin 1540-PE*

Midget "Megger" Circuit Testing Ohmmeters—0.1–200,000 ohms. *Bulletin 1495-PE*

To Measure Speed, Frequency and Rates of Vibration. "Frahm" Vibrating Reed Frequency Meters. *Bulletin 1770-PE*

"Frahm" Vibrating Reed Tachometers and Vibration Indicators. *Bulletin 1590-PE*

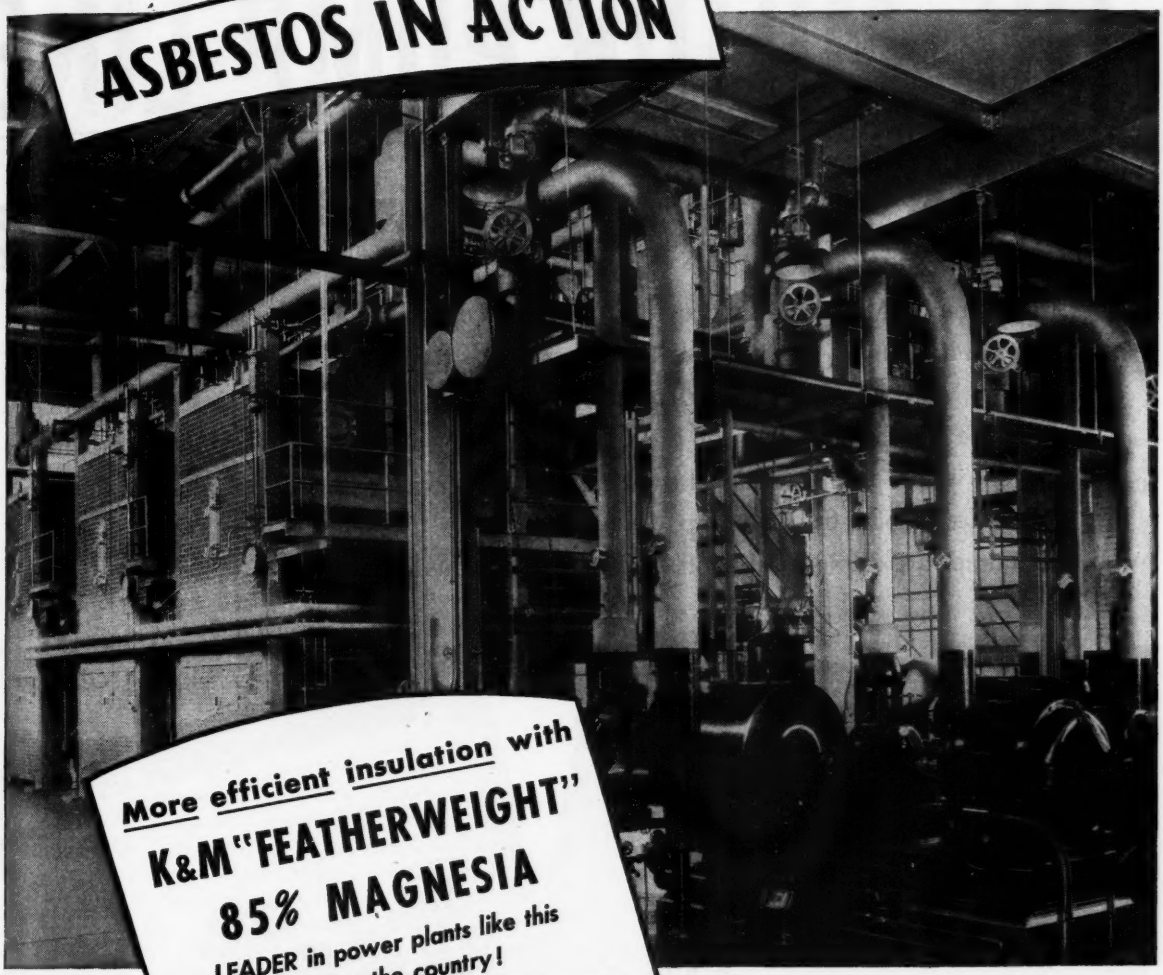
"Jagabi" Precision Tachometers, Centrifugal and Chronometric Types for Hand use. *Bulletins 1790-PE and 1800-PE*



"Jagabi" Slide Wire and Carbon Rheostats. Wide variety of types and ratings. *Bulletin 1745-PE*

JAMES G. BIDDLE CO. • **1211-13 ARCH STREET PHILADELPHIA 7, PA.**

ASBESTOS IN ACTION



More efficient insulation with

K&M "FEATHERWEIGHT" 85% MAGNESIA

LEADER in power plants like this all over the country!

. . . AND HERE'S WHY!

Carbonate of magnesia is an *exceptional* insulating material because of the great number of microscopic dead air cells it contains. Asbestos fibre is added for structural strength. In the manufacture of K&M "FEATHERWEIGHT" the quality and percentage of carbonate of magnesia used is carefully controlled . . . hence its high efficiency and wide acceptance by industry.

Remember, "FEATHERWEIGHT" offers:

- **Lasting effectiveness**
- **Durability**
- **Dependability**

Besides being a fuel-saver, K&M "FEATHERWEIGHT" 85% MAGNESIA is maintenance-free. Engineers recognize its superiority over all other insulations because it is free from any danger of disintegration or material chemical change at average temperatures up to 600° F.

Nature made Asbestos . . . Keasbey & Mattison has been making it serve mankind since 1873, while K&M "Featherweight" has been known as a symbol of *quality* for 59 years!

KEASBEY & MATTISON

COMPANY • AMBLER • PENNSYLVANIA

THE MOTOR PUMP LINE

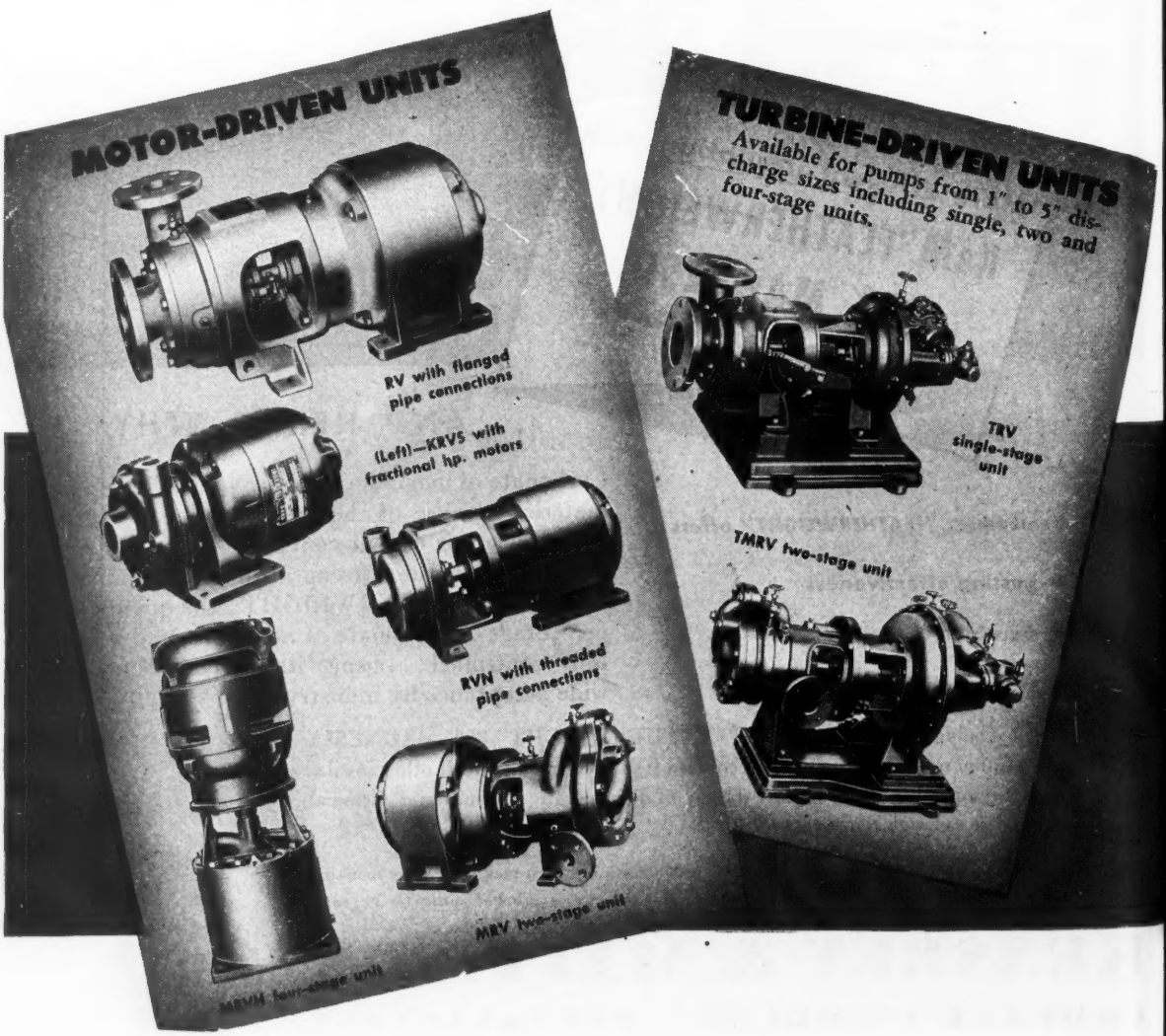
AN INGERSOLL-RAND *Service*

The line of Motorpumps provides the most complete selection of pumping units within its range. (Capacities to 1800 gpm, heads to 600 ft.).

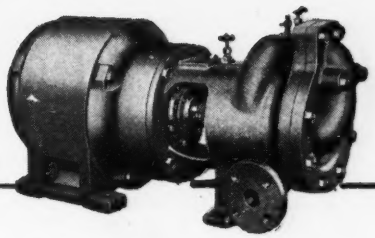
The Motorpump is a compact and efficient centrifugal pump having the impeller and the rotor of the motor on the same shaft. Pump and driver are a single rigid unit.

The same pump casing and parts combined with a turbine produce a similar compact turbine-driven pump.

Pumps are also available on cradles for any type of drive.


MOTOR-DRIVEN UNITS
RV with flanged pipe connections
(Left)—KRVS with fractional hp. motors
RVN with threaded pipe connections
MRV two-stage unit
MRVH four-stage unit
TURBINE-DRIVEN UNITS
Available for pumps from 1" to 5" discharge sizes including single, two and four-stage units.
TRV single-stage unit
TMRV two-stage unit

1/4 To 50 HP.



TO ALL PUMP USERS

Where Motorpumps can be used — Motorpumps can be used wherever liquids must be pumped. Tens of thousands are in use in the petroleum, chemical, and other industries handling not only water, but an almost unlimited variety of other liquids.

Range of Sizes — Single-stage Motorpumps are available in discharge sizes from ¾" to 5" to handle capacities up to 1800 gal per min against heads up to 250 ft (110 lb per sq in). Two-stage and four-stage units handle up to 500 gal per min against heads up to 600 ft (260 lb per sq in). Often it is economical to use several Motorpumps together to obtain still larger capacities.

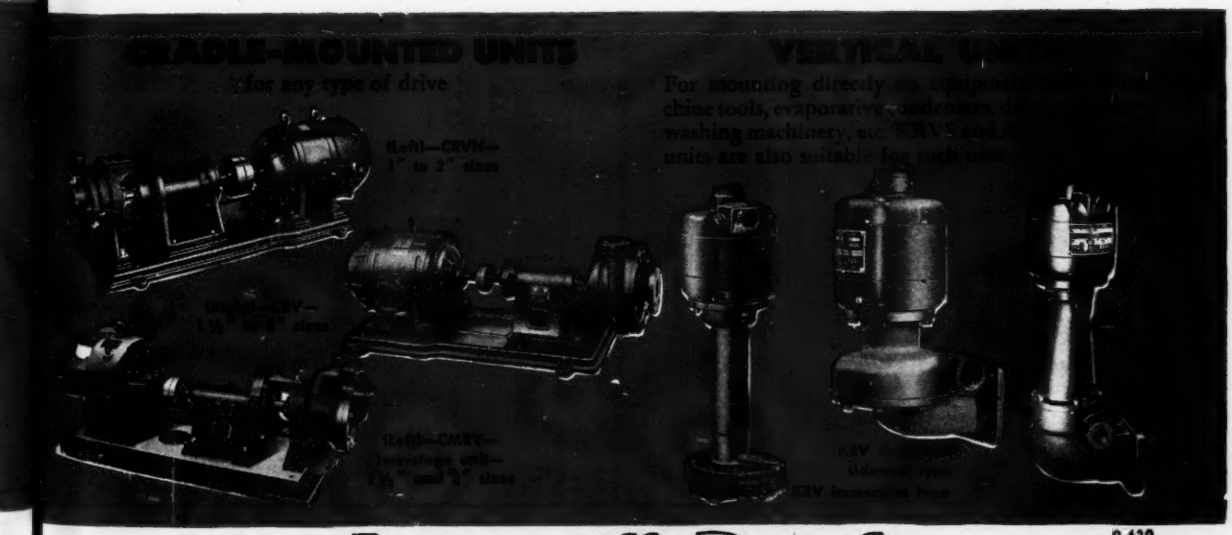
Modifications extending range of usefulness – Motorpumps are available in three standard material combinations; all iron, bronze fitted and all bronze, to handle a wide variety of liquids. Other modifications include open impellers for paper stock or viscous liquids, grease-sealed stuffing boxes or mechanical seals for petroleum products, hardened shaft sleeves and shrouded wearing rings for abrasive liquids, smothering glands, and water-cooled stuffing boxes for hot liquids, sling-yoke mounting for mine-shaft service.

Economical to use —Motorpumps are built on a production basis in a plant devoted exclusively to the manufacture of pumps. They are, therefore, economical in first cost. Moreover, they are quality units in every respect. Features such as heavy shaft, large ball bearings, sealed shaft sleeves and rigid construction assure long life. Their high efficiency keeps power requirements at a minimum. Their compactness cuts down installation cost and saves floor space which is often at a premium—they can be mounted on a wall or ceiling.

Availability—At one time we could and did say "Wire us for a Motorpump and we will ship it within 24 hours". We hope we can soon return to that basis. In the meantime, we can often give you shipments better than you expect under wartime conditions. Motorpumps are carried in stock by Ingersoll-Rand branch offices and by many dealers. This stock arrangement sometimes enables us to perform miracles even under today's difficulties.

* * * *

The Motorpump Catalog contains full information. Write our nearest branch for your copy—and for any engineering assistance. Ingersoll-Rand Company, 11 Broadway, New York 4, N. Y.



9-639

Ingersoll-Rand

11 BROADWAY, NEW YORK 4, N. Y.

WAR SERVICE AGAIN PROVES

Super Efficiency of

NEK-SEAL Packing style No. 501. Excellent for centrifugal and reciprocating pumps. Once installed it forms a fine bearing surface and becomes a practically permanent packing.

What is the **"NEK-SEAL"**

It is an inlaid fillet of lead antimony alloy which forms a perfect anti-frictional seal of bushing clearances. It is an EXCLUSIVE patented process.

- Power loss and blow-by are eliminated.
- Prevents packing being forced into cylinder.
- Increases strength and resiliency of packing itself.

CENTRIFUGAL PUMPS, reciprocating rods and valve stems packed with "NEK-SEAL" gave steady, reliable, trouble-free service right through the toughest years of the war. Owners of fleets of cargo ships and oil tankers, as well as industrial manufacturers all over the country, will attest the SUPER EFFICIENCY of NEK-SEAL packing.

The war has introduced NEK-SEAL to many an engineer. Have you given it a trial?

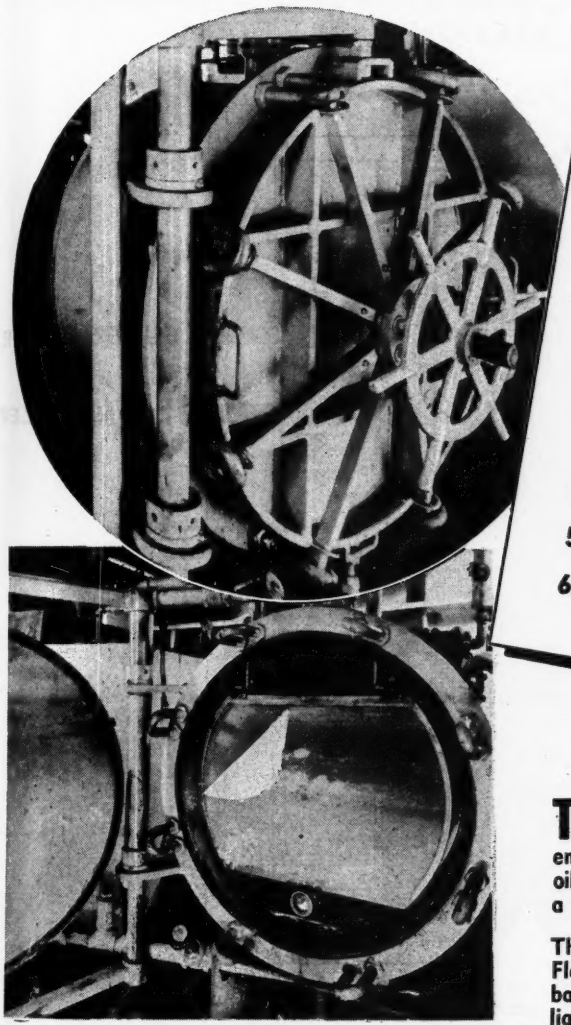
Let our engineers show you how SEA-RO Nek-Seal can eliminate pump packing troubles. New Catalogue on request.

SEA-RO

PUMP PLUNGER RINGS
NEK-SEAL PACKING

SEA-RO PACKING COMPANY • WOOD-RIDGE, NEW JERSEY

Removes ALL OIL from condensed returns used for boiler feed



Upper picture shows the Refiner with special quick-locking door in place. Lower photo shows door open. Note how filter bed is peeled easily from pressure leaves in one piece.

The REFINER

A revolutionary new filter PROVEN IN SERVICE

1. Eliminates oil entering boilers. Improves boiler efficiency. Reduces boiler maintenance costs.
2. Saves heat units and fresh water by clarifying contaminated returns formerly dumped.
3. Removes free and EMULSIFIED oil from water to less than one-tenth part per million.
4. Requires no chemicals or wasteful back-washing.
5. Is simple, inexpensive to operate.
6. Requires little space.

THE REFINER is an outstanding achievement in filters designed for extremely fine filtration. It breaks the tightest emulsion in condensate and removes both emulsified and free oil from an oil content as high as 90 parts per million down to a guaranteed maximum of one-tenth ppm.

The **REFINER** features compactness and low-cost operation. Flow rates of 20 to 200 gpm are obtained in single units. A battery of units provides greater capacities. The cost of filtered liquid by this new method of emulsion breaking is extremely low. No back-wash water is used.

The **REFINER** will greatly step up the efficiency of your plant and reduce boiler maintenance costs. Engineering assistance will be furnished gladly.

Write for Catalog

APPLICATIONS

The **REFINER** can be used as a polishing filter for practically any liquid, including boiler feed water and condensate, alcoholic, malt and other beverages, chemicals, aromatics, paints, varnishes, lacquers, soaps, detergents, juices and liquid foods, and liquids used in processing other substances. The pressure-tight cylinder permits filtration of volatile, inflammable, and hazardous liquids. It also removes turbid matter of the same specific gravity as the liquid.

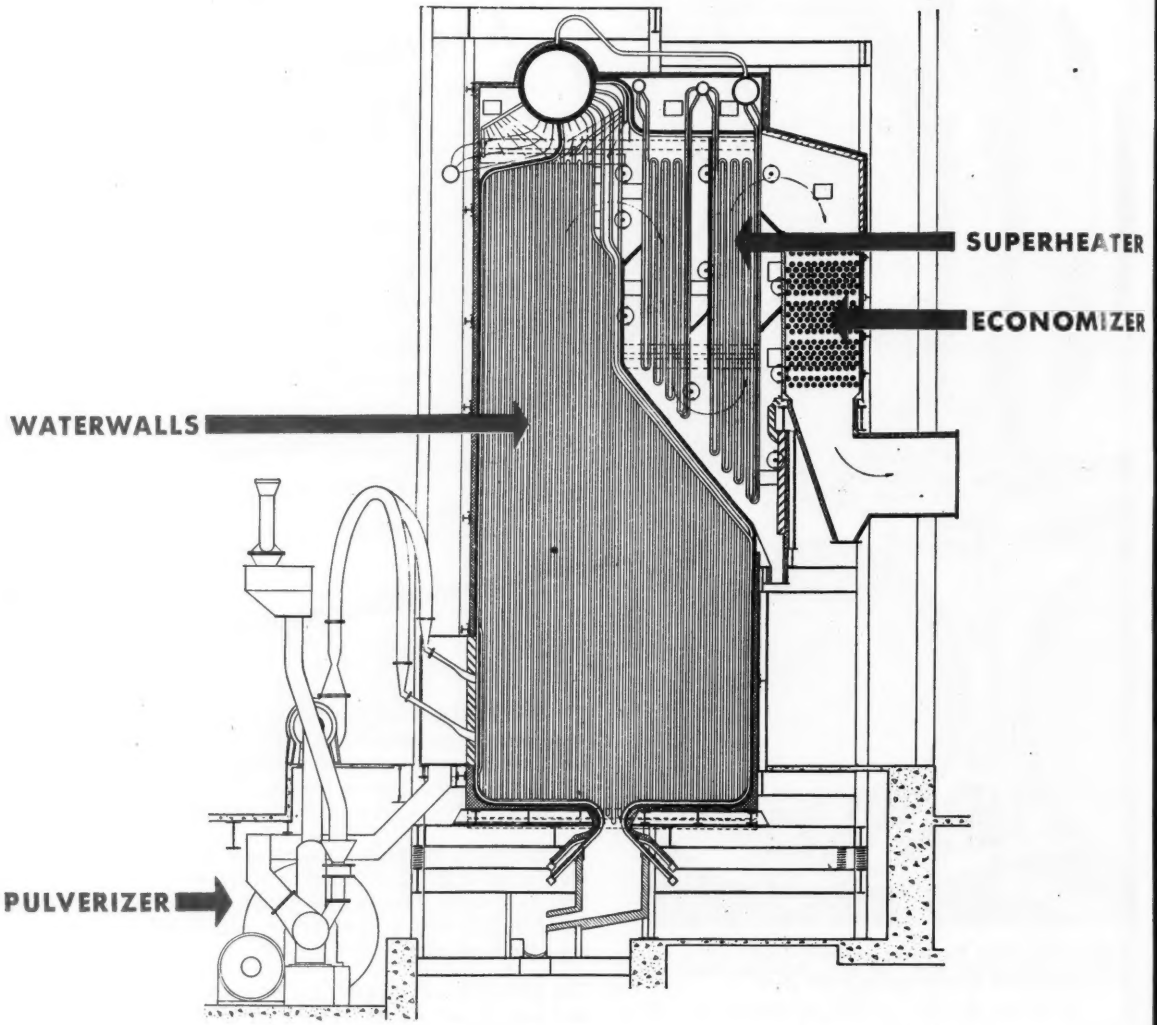
BLACKBURN-SMITH
MANUFACTURING COMPANY, INC.
For 60 years designers and manufacturers of filters
66 River Street, Hoboken, N. J.

Blackburn-Smith Mfg. Co. is a wholly owned subsidiary of Condenser Service & Engineering Co., Inc., builders of Evaporators, Stage Heaters, Gas Coolers, Drain Coolers and Heaters, Aftercoolers, Air Preheaters, Fuel Oil Heaters, Jacket Water Coolers, Process Heat Exchangers, Transformer Oil Coolers, Generator Air Coolers, Lubricating Oil Coolers, Storage Tank Oil Heaters, Feed Water Heaters, Distillers, Industrial and Oil Refinery Heat Exchangers, and other type of heat exchange equipment.

WHAT IS THIS

COLUMBUS AND SOUTHERN OHIO ELECTRIC CO.

WALNUT STATION



Maximum Load: 325,000 lb., steam per hour, 1400 lb., per sq. in. pressure, 900° F. final steam temperature

Foster Wheeler Corporation,

FOSTER

BOILER RATING?

The heating surface of this modern steam generator* is comprised of the following heat absorbing areas:

	Percent of total heating surface
SUPERHEATER	42.6
ECONOMIZER	37.2
WATERWALLS	20.2
BOILER TUBES	0

For 47 years Foster Wheeler has pioneered in the development of pulverized fuel systems and the three heat absorbing surfaces essential for modern central station steam generating units.

1898 **PULVERIZED FUEL** developed on a commercially successful scale.

1904 **SUPERHEATERS**—introduced the commercial use of superheated steam in the United States.

1919 **ECONOMIZERS**—introduced the forced circulation, high draft loss, counter-current, unit economizer.

1923 **WATER COOLED WALLS** for many types of furnaces burning various fuels.

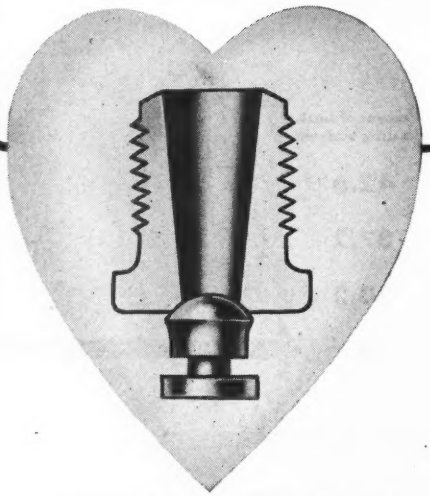
*Exclusive of regenerative air heater

165 Broadway, New York, 6 N. Y.

WHEELER FW

New HI-CAP Orifice Gives STRONG Traps

UP TO 25% *greater* CAPACITY



THE heart of the improved STRONG Trap is this HI-CAP* Valve and Seat assembly. New, scientifically designed orifice throat gives up to 25% greater capacity, avoids turbulence and minimizes choking caused by flash steam. *An important part of STRONG service is continued attention to parts for traps in service. HI-CAP parts are available for your present 70 series traps.*

*HI-CAP—Registered trade mark

STRONG 2-IN-1 TRAPS

THE STRONG "T" Traps combine in one unit the economies of inverted bucket traps with air removal capacity of the thermal traps. They are particularly suited to equipment or processes requiring quick air and condensate removal for rapid heating up.

The "T" type is included in the new line of HI-CAP straight-through traps in sizes from 1/2" to 1-1/4". With the new STRONG HI-CAP Traps . . . both standard and thermal . . . you get:

- HI-CAP orifice
- Screwed in ANUM-METL valve and seat
- Straight-through or elbow piping
- All stainless steel trim

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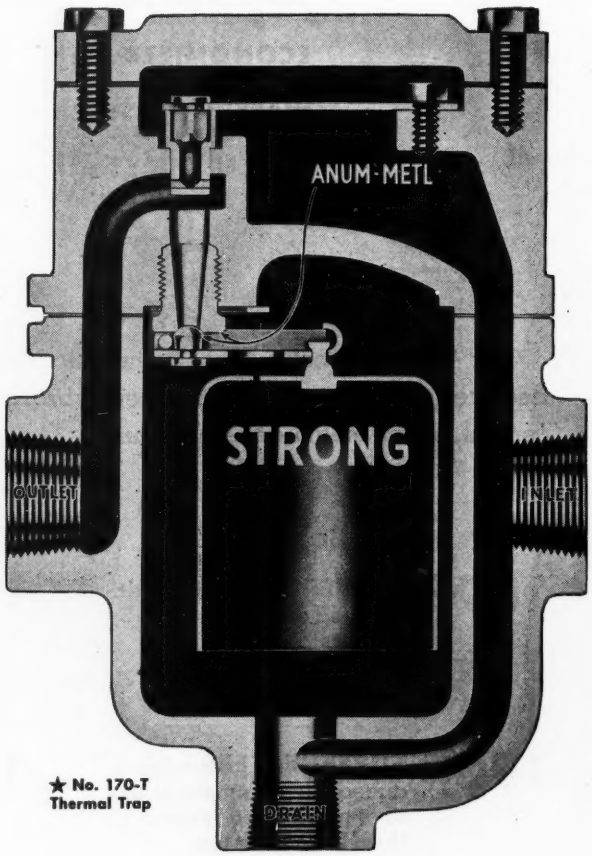

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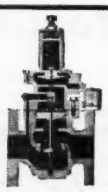

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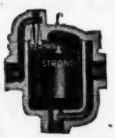
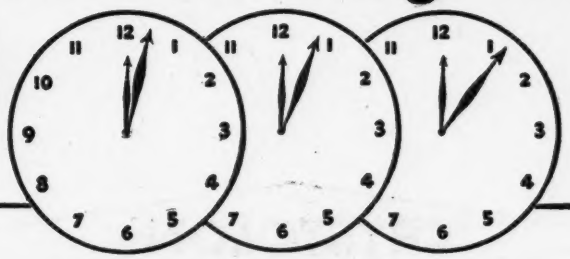


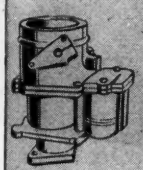
HI-CAP Inverted Bucket Traps

How to Cut Metal Cleaning Time to MINUTES



NEW, FAST-ACTION DETERGENT CLEANS FERROUS AND NON-FERROUS METALS...Easy to Handle

TYPICAL USES FOR Solvent "26"



CARBURETORS—Solvent "26" removes gum, gasolene sediment and other accumulations of dirt.

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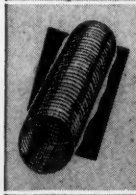
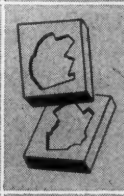


METAL PLATES AND SCREENS—Solvent "26" restores clear, clean finish to any metal surface.



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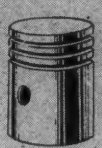

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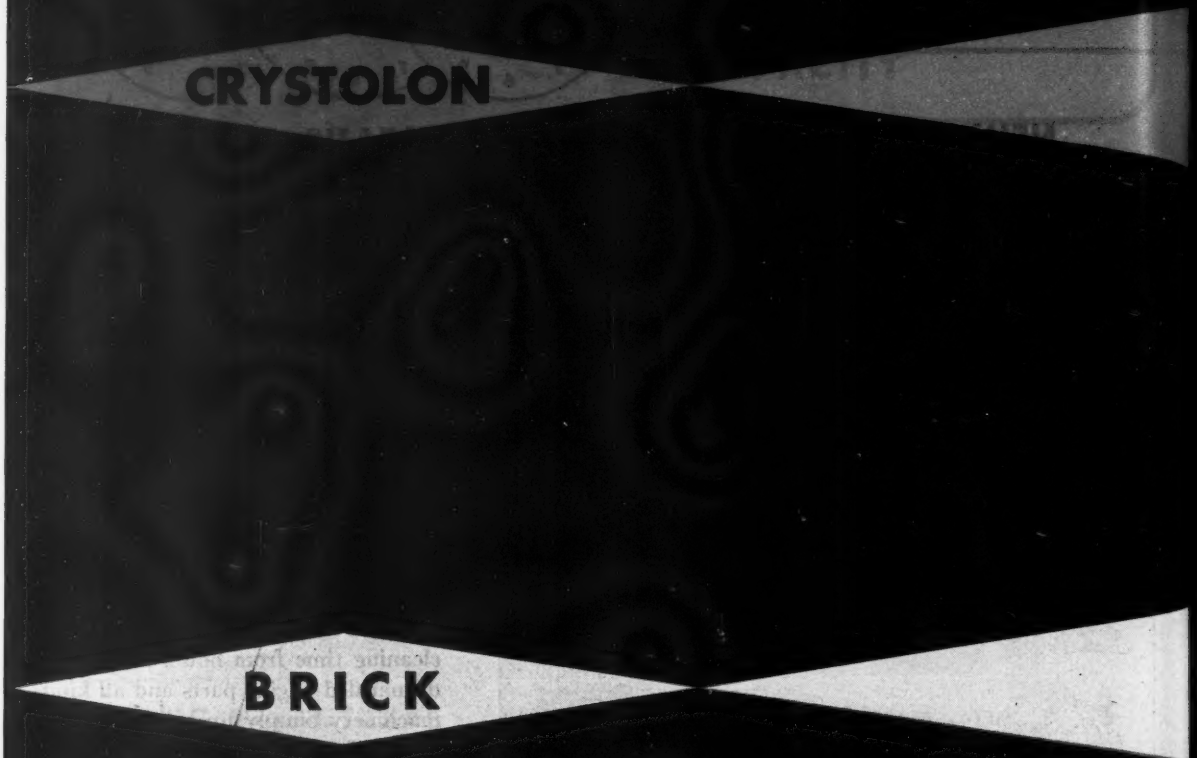
Stretching Generator Lining Life



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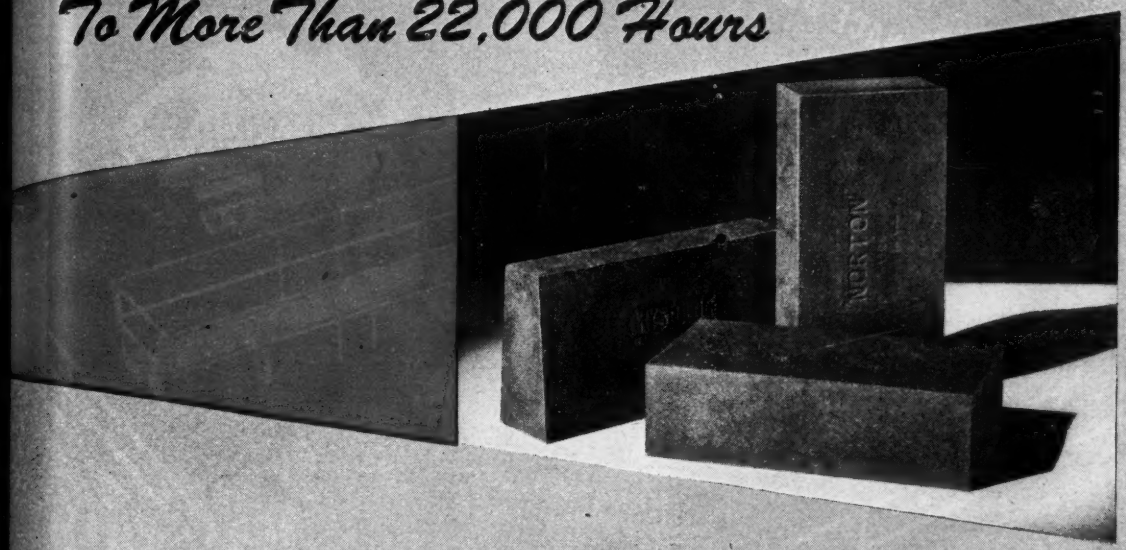
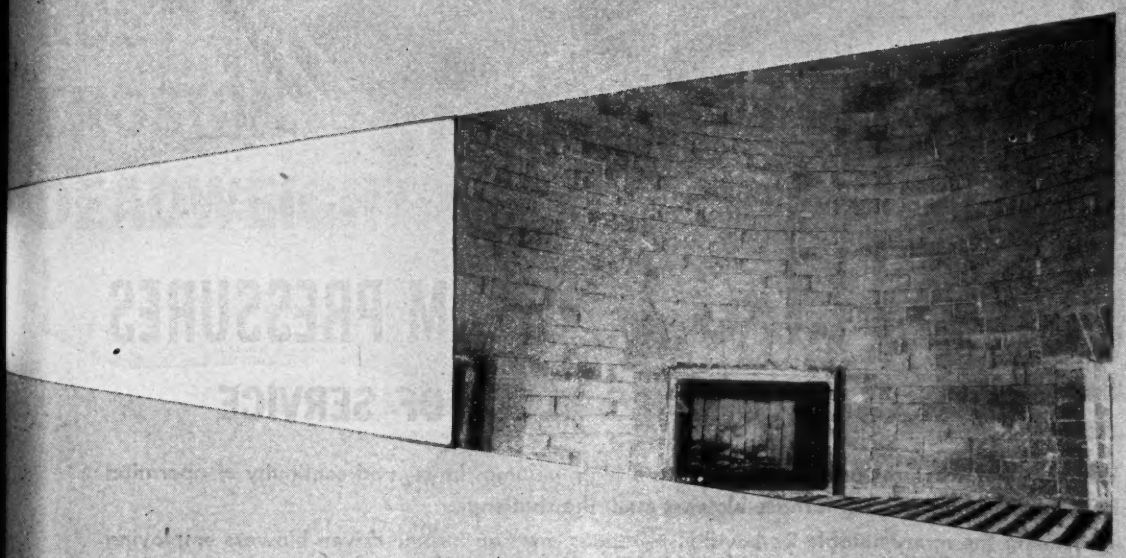
To More Than 22,000 Hours





Not only do CRYSTOLON Brick stretch the life of generator linings very considerably, due to their refractoriness, chemical stability and resistance to the penetration of molten ash, but also these silicon carbide brick often pay for themselves the first year by savings in cleaning cost alone. Among water gas plants, in generator after generator, CRYSTOLON Brick are increasing lining life, reducing cleaning time. An important feature of CRYSTOLON Brick is that their dense, hard surface resists slag penetration and therefore the clinker ring is quickly broken free, leaving the surface of the lining clean and undamaged for further service.

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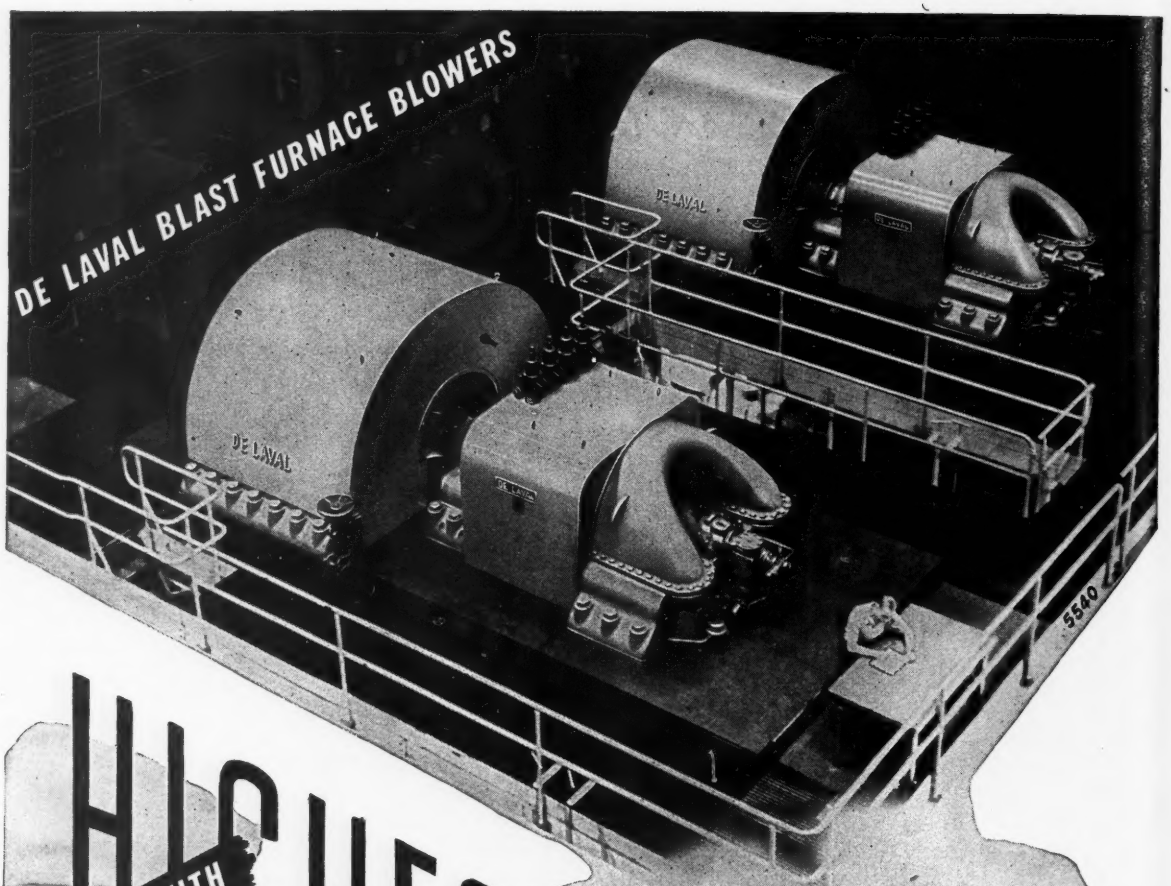

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EVER USED FOR THIS CLASS OF SERVICE

Where steam pressures and temperatures are high, volumes large, and continuity of operation imperative, De Laval blast furnace blowers meet the challenge.

Among the many notable De Laval installations are two turbine-driven blowers employing the highest steam pressures and temperatures ever used in the United States for this class of service. These units are installed at the Edgar Thomson Works of the Carnegie-Illinois Steel Corp. Designed for steam at a maximum pressure of 700 psig and 825 F., they operate under conditions comparable to those employed for modern power generating units. The blowers have a capacity of 97,800 c.f.m. against 30 psig.

Our engineers will be glad to study your blower and compressor requirements.

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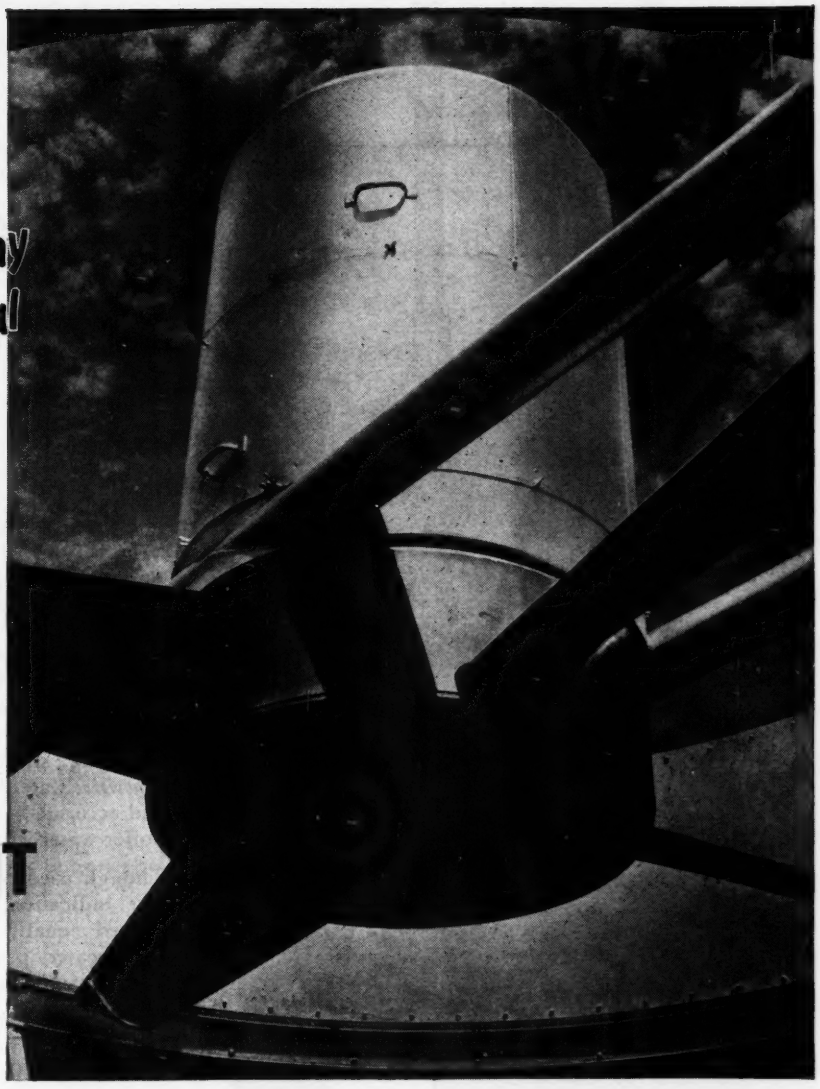
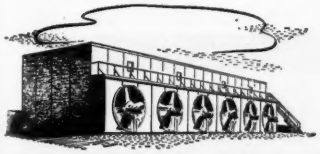
How one company selected a metal to fight...

CORROSION
RUST
EROSION
DEADWEIGHT





J. F. Pritchard & Company of Kansas City, Mo., are among the biggest builders of cooling towers.

In their forced-draft type, air enters near the bottom and courses upward, absorbing heat from the falling water.

The fans that move the cooling air do a *big* job. Diameters range from 7 to 14 feet; number of blades, from two to six. The larger fans handle up to *400,000 cubic feet of air per minute.*

Two factors in the success of Pritchard towers are the design of the huge fans... and the choice of metal.

To withstand corrosive industrial atmospheres and moisture-laden air, the blades are made of wrought Monel, and are individually bolted to Monel hubs. To save weight, the blades are of airfoil section with "stressed skin" design.

Here's what Pritchard says of the metal they have standardized upon:

> **"Built of non-corroding Monel, these fans have practically unlimited life... Because they weigh only half as much as other fans, they lengthen driving-equipment life... Because they do not pit from erosion, they maintain their original high efficiency."**

And here's a lesson for you! When buying equipment, be sure to ask the manufacturer if the vital parts are made of Monel, "S" Monel, "K" Monel or some other INCO Nickel Alloy. If they *are*, you can be certain that the manufacturer has built-in long, economical service right from the start.

By fighting corrosion, rust, wear, fatigue and heat, these strong alloys can add life to your pumps, valves, gaskets, packing, tanks, heat exchangers and other equipment. The International Nickel Company, Inc., 67 Wall Street, New York 5, N. Y.

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Wide Acceptance!

Though introduced only recently, thousands of Yarway Remote Liquid Level Indicators already have been bought . . . and the list of satisfied users reads like a Who's Who of Industrial Plants, Utilities and Institutions.

There *must* be a reason. There *is!*

The Yarway Remote Liquid Level Indicator brings overhead gage readings right down to eye level, on the instrument panel or other convenient place. No more squinting, straining and guessing. Here is *positive* water level indication . . . instant and accurate because it's operated by the boiler water itself.

Though used primarily for boiler water level indication, the Yarway indicator has proved equally successful in indicating superheater pressure differential, feedwater-heater levels and other liquid levels.

Write for Bulletin WG-1820, or see this indicator and hear its operation explained by Lowell Thomas in the new Yarway color motion picture, "There Is An Engineering Reason", now available for group showings. Write for details.

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WHAT LEADERS SAY

How Good Was German Science?

By DR. A. ALLAN BATES

AS THE only metallurgist in a picked group of 30 scientists that went into the Reich as a combat-trained unit, I personally questioned Germany's leading men of science, many of whom were captured by the specially-trained Army intelligence unit.

I cannot reveal just what the Germans were doing on atomic power, but they were working on it and with good results. They knew of uranium fission and how to get it. In fact they knew practically as much about it as we did, but were far from putting their knowledge into effect because of the incapicitation of their industrial plants.

At the present time, no other nation in the world could have built an Oak Ridge, Tenn., the "atom city" of 80,000 created to produce this new weapon. No other country was close to harnessing atomic power at the time our forces dropped atomic bombs on Japan, but other nations can and will discover its secrets in the near future.

Ten years from now, a lot of countries will have worked out the secrets in their own scientific laboratories and will have the means for putting them into effective use. Widespread knowledge of atomic power uses and other powerful weapons already produced and in the course of development will make military manpower a much less potent factor in war.

Right now the United States has the greatest concentration of scientific brain-power in the world—a force of able American scientists abetted by many learned nuclear physicists who came to this country as refugees. Certainly, we have the greatest engineering and industrial capacity in the world. But what we have done can and will be done by others in time.

After seven months with the special intelligence unit that not only questioned scientists but studied scientific laboratories in occupied Germany, I returned unimpressed by activities of the alleged "supermen of science."

It is a fact that, with a few notable exceptions, they really did a much less thorough job than we have done in the United States. In only one or two specialized fields, such as aerodynamics and jet propulsion, did their research effort approach ours. The many scientists we captured and questioned were almost uniformly glad to tell us everything they knew and the majority were bitter over the manner in which the Nazis had treated German science.

On the other hand, Nazi industry and engineering had done a good job of producing war machines. In spite of this, the German army was pitifully undermechanized to fight against the highly superior mechanization launched by the Allies.

Germany undoubtedly was ahead in the field of rockets and jet propulsion—the fields which developed the V-1 and the V-2 flying bombs. But contrary to general belief, most all of their ideas on radar were taken from a study of such equipment on Allied planes which had been shot down and, at the end of the war, they remained far behind in its development. Germany did not have any worthwhile secret weapons almost ready for combat use.

We found some of the top German scientists almost childish in their inability to be practical. One professor, selected by Goering to organize all German science, had spent much time on development of a bomb that descended in large spirals so that, as he put it, 'people wouldn't know where it was going to strike.' The childish part of this was that the Germans didn't know where it was going to strike, either, and they seemed to fail to realize that it is almost impossible for persons on the ground to judge the striking point of a bomb, whether it spirals down or comes down almost straight. This was to be a 'mother' type of bomb that scattered smaller bombs before it hit—a device that the Russians had in use for some time.

Dr. A. Allan Bates is manager of the Chemical and Metallurgical Department of the Westinghouse Electric Corp. Research Laboratories. He was graduated from Ohio Wesleyan University in 1923 with a degree of AB, and in 1927 he received from the Case School of Applied Science an MS. Winning a fellowship, he went to France to study at the Ecole de Metallurgie in the University of Nancy and there received a DSc. He joined Westinghouse in 1937 after 12 years at the Case School of Applied Science as professor of metallurgy. As a member of the Army intelligence unit in Germany, he had the assimilated rank of a colonel. The above remarks are from an address delivered recently by Dr. Bates before the Hungry Club of Pittsburgh.

Steam and Blast-Furnace Air for *Fontana*

By H. H. Hyde

Bechtel-McCone-Parsons Corp.

Power plant supplies air to blast furnace at Fontana, Calif., iron and steel plant of Kaiser Co., Inc., also steam for blast furnace and coke ovens . . . Electric power now purchased . . . Two steam-turbine driven blowers deliver maximum of 100,000 cfm each at 30 psig . . . Steam is generated at 400 psi, 700 F by three integral-furnace boilers, total peak capacity 425,000 lb per hr . . . Main fuel is blast furnace gas, supplemented by coke oven gas and oil, under automatic combustion control . . . Air mixed with H_2S from coke oven gas lines introduced into furnaces with combustion air . . . Problems in combustion control . . . Air heater tube temperatures controlled to prevent corrosion at light loads . . . Steam-driven auxiliaries to insure service continuity, with some motor drives for heat balance adjustment . . . Electrostatic precipitators keep sand out of turbo-blower intake air during sandstorms . . . Plant designed for expansion; first on West Coast to burn blast furnace gas

SET IN THE MIDST of orange groves, surrounded by lawns and flowers, in a section of California given over principally to orchards, vineyards and truck gardens, the Fontana Iron and Steel plant of Kaiser Co., Inc. about 50 miles east of Los Angeles, has been likened to the work of some Hollywood motion picture wizard.*

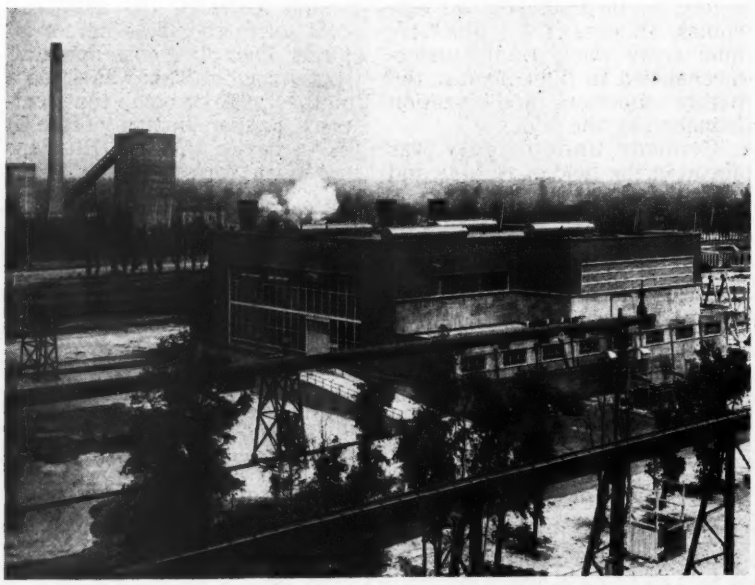

Fig. 1. General exterior of power plant at Kaiser steel plant, Fontana, Calif., showing modern building design, piping for blast furnace gas, sulphur-laden air on far side of building, 48-in. blast air pipe on near side

The plant at Fontana was erected by Kaiser Co., Inc., and was financed by the Reconstruction Finance Corp., to supply steel made from California ore for the making of plates for the shipbuilding yards on the Pacific coast that were fabricating ships for use in the Pacific war theater. Ground was broken for the plant in April 1942, and the blast furnace was blown in less than nine months later on December 30.

The plant includes one blast furnace of 1200 tons capacity, coke ovens, six 185-ton open hearth furnaces, one electric furnace, and plate, structural, and merchant mills. Annual rated capacity of the plant is 700,000 tons of steel ingots, 432,000 tons of pig iron, 300,000 tons of sheared plates, 210,000 tons of structural shapes, 180,000 tons of merchant mill products, and great quantities of coke-oven by-products such as benzol, toluol, creosote and the like.

The builders of the plant consider that this plant is not merely a "war baby" but that it may be a permanent foundation for a West Coast steel and industrial development.

The mill is now being expanded to produce a supply of diversified steel products, all from western resources

*For detailed description of the steel plant and its operation, see Compressed Air Magazine, March, 1944, pages 56-63.

and without dependence upon Eastern supplies.

To serve this steel mill with necessary power services, the power plant described in this article was built as an integral part of the development.

General Plant Design

The primary purpose of the power plant is to supply air to the blast furnace. The plant also supplies steam at reduced pressure and temperature to the blast furnace and to the adjacent coke ovens, where coke is produced by distillation of coal. These loads are variable and are partially carried by waste heat boilers in the open hearth plant.

Equipment at present installed in the power plant consists of three 400-psi boilers with necessary auxiliaries; two steam turbine-driven blast blowers for operation on 400-psig, 700 F steam, with condensers, circulating water system, etc.; two 1000-kw motor generator sets; electric distribution and control switchgear and transformers for plant service and for distribution to other loads. Complete details of main and auxiliary units are given in the list of equipment, page 78.

The present plant is housed in a building 180 ft wide by 160 ft long, Fig. 1. The plant is so arranged that the building may be extended and additional blast furnace blowers added at one end, with corresponding increases in boiler capacity extending in both directions. The building housing this ultimate plant will be approximately 180 ft wide by 420 ft long.

The ends of the present buildings are of temporary steel and glass construction, and are designed so that they may be taken down and moved to the ends of the ultimate structure without loss of material. The architectural treatment of the building was carefully studied and was made to conform to the general architectural scheme of the entire steel plant as established by the Kaiser Co., Inc.'s. engineering staff. The result is a clean-cut, well-lighted building of pleasing appearance which fits well into the surroundings.

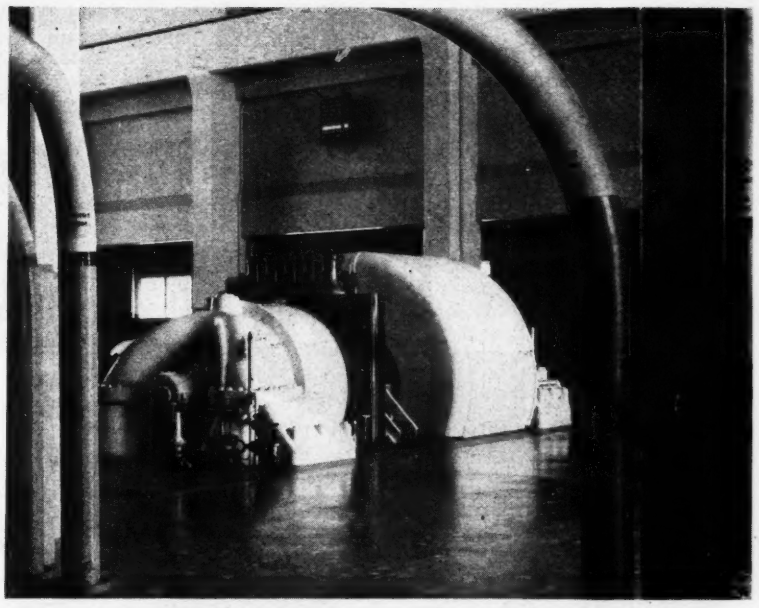

Fig. 2. View of one of the Fontana turbo-blowers

One unique feature of the plant is the building construction itself. This structure is primarily of concrete, using concrete columns, floors, and side walls to an elevation just below the roof. The platforms and intermediate walks in the boiler room around and above the boilers are also of concrete construction, as are the temporary ends of the building. The roof is supported on steel roof trusses and consists of box-type roof sections covered with insulating board and a built-up construction roofing.

Blast Furnace Turbo-Blowers

It is not usual practice to locate blast furnace blowers at great distances from the blast furnaces but in this case it is planned ultimately to have four blowers in one building serving three furnaces at distances of 1500 to 2000 ft from the blowers. The present plant serves a single blast furnace, and a pipe line 48 in. in diameter about 1500 ft long delivers air from either of the existing blowers to the furnace.

When plans for the steel mill were started, it was found that a blower capable of delivering up to 100,000 cu ft of free air per minute at 35 psig pressure would be desirable. At that time, delivery of such a machine could not be obtained in less than

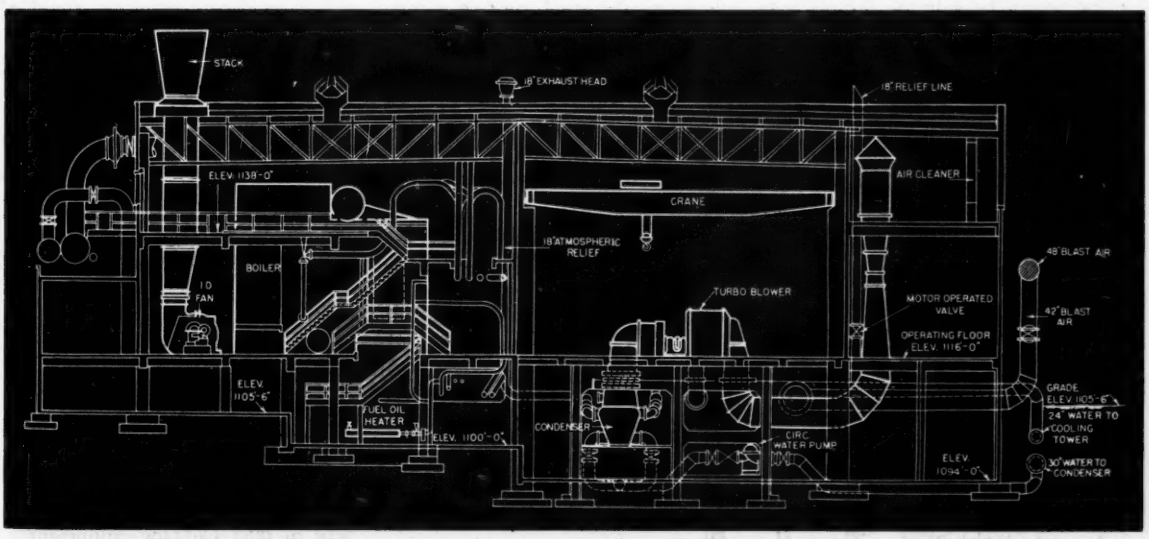

Fig. 3. Cross-section of Fontana power plant, looking east, showing turbo-blowers and auxiliaries, boilers and auxiliaries

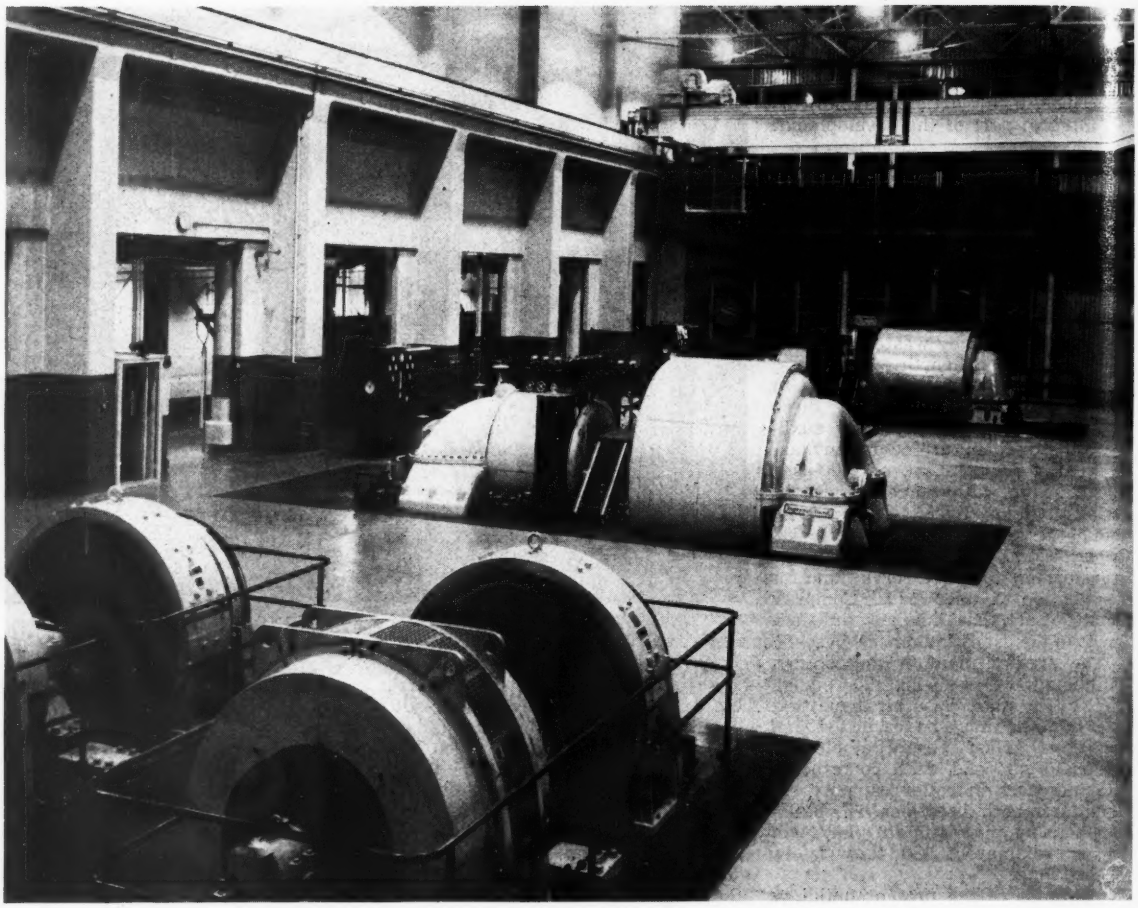

Fig. 4. Interior view of Fontana power plant showing two 100,000-cfm turbo blowers

18 to 24 months, which was much too late to allow completion of the plant on schedule. It was found, however, that a machine capable of delivering 100,000 cfm at a maximum of 30 psig could be obtained in a much shorter time and, as this machine would be suitable for all but the most severe pressure conditions, it was decided by the Kaiser Company, Inc. management to install one of these smaller units first and follow this with one of the larger units as soon as available. It is planned to install one of the larger blowers for each blast furnace in the ultimate development of the steel plant and to retain the smaller machine as a spare or standby unit. Plans for the complete power plant provide for connecting the small unit so it may be used with any one of the blast furnaces.

The blast furnace blowers are equipped with automatic controls to maintain a constant flow of air at any set rate. The operation of a blast furnace is such that the pressure in the furnace may vary, but the quantity of air delivered to the blast furnace must be constant regardless of the pressure variations. To accomplish this, a venturi section is installed in the inlet pipe to each blower as in Fig. 3, and the differential produced by this venturi section is used to control the speed of the drive turbine to maintain a constant air flow.

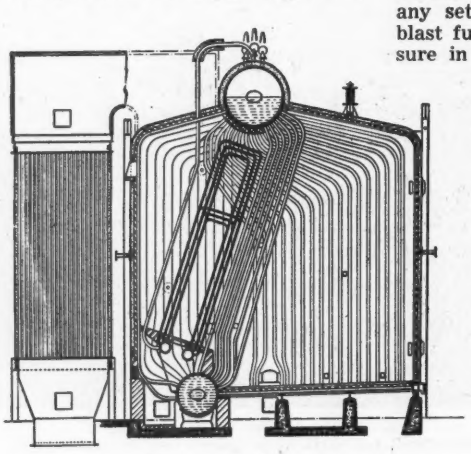

Fig. 5. Cross-section of one of the integral furnace boilers, with its vertical tubular type air preheater

Cleaning Blower Intake Air

Climatic conditions at the plant are rather severe in that during the summer temperatures in excess of 100 F are maintained for considerable periods and, at certain times of the year, severe dust storms are encountered. The severity of these dust storms is sufficient to sandblast windows and completely remove the paint from automobiles and other painted articles. As the large quantities of abrasive sand and dust carried in the air during these storms will cause excessive wear and possible failure in the large and costly high speed rotors of the blast furnace blowers, the air intake chamber for the blowers has been provided with an electrostatic precipitator to remove all dust particles. This is the first application of this type of dust cleaning equipment to large blowers serving a blast furnace.

Experience during recent dust storms has proved the effectiveness of this installation.

The steam turbines driving the blast furnace blowers exhaust to two-pass condensers designed so that with 12,000 gpm of 80 F water, they will produce 28 in. vacuum at full load. With one-half of the water side out of service, they will carry full normal load at 26.95 in. vacuum with 6100 gpm of water circulating.

Water supply for these units is obtained from induced draft cooling tower and is circulated by 12,300 gpm circulating pumps, one turbine driven and one motor driven. Details of turbine and condenser auxiliaries are given in the list of equipment.

Steam Generating Units

Steam for the turbines driving the blast furnace blowers is generated at 400 psig, 700 F by three integral furnace type steam generating units. Two of these have a rated capacity ranging from 115,000 lb per hr each when burning blast furnace, coke oven gas and oil, in any combination, to a peak capacity for a short time of 160,000 lb per hr each burning coke oven gas and oil. The third unit has a capacity of from 75,000 lb per hr on blast furnace gas alone to 105,000 lb per hr with coke oven gas and oil. Thus the total peak load capacity is about 425,000 lb of steam an hour.

These units are of the standard integral furnace type, Fig. 5, and need no detailed description. Complete details of them are given in the list of equipment.

They are fired by combination blast furnace and coke oven gas burners with auxiliary steam atomizing oil burners.

Draft is supplied by one forced and one induced draft fan per boiler. Each forced draft fan on Boilers 1 and 2 is equipped with dual drive by 160-hp 400-psi, 700 F geared turbine and 200-to-50-hp, two-speed variable-torque, line-start electric motor. Each No. 1 and No. 2 induced draft fan is equipped with dual drive by 400-hp geared steam turbine and 450-112-hp two-speed two-winding induction motor. Fans on boiler No. 3 have turbine drives only.

Air preheaters are of the vertical tubular type, installed directly behind the boilers. Each is designed to heat combustion air for the burners to 530F when reducing flue gas temperature to 500F.

The induced draft fans discharge to three short stacks projecting only a short distance above the building roof line, as in Fig. 1.

Controlling Three Boiler Fuels

The plant is supplied with three separate fuels for use in the boilers. The main or primary fuel is blast furnace gas which has a heating value of approximately 85 Btu per cu ft and is supplied directly from the gas washers and electric precipitators at the blast furnace. Coke oven gas from the coking plant having a heating value of about 550 Btu per cu ft is supplied as a secondary fuel for use in conjunction with the blast furnace gas when the quantity of blast furnace gas available is insufficient for the plant load. Fuel oil is available as an emergency or standby fuel.

The boilers are equipped with automatic combustion controls to automatically maintain constant steam header pressure and to take full advantage of the availability of blast furnace gas. These controls automatically cut in the coke oven gas as necessary to maintain the plant load. Oil may be fired in conjunction with either blast furnace or coke oven gas or by itself, all with automatic control.

The multiplicity of fuels used in this plant eliminates the need for duplication of any of the fuel lines as any one system can be completely shut down for repairs or alterations or expansion, and the entire plant can be operated on one or more of the other fuels.

Blast furnace gas is carried to the plant in a 60-in. diameter pipe. The coke oven gas, having higher Btu value, is supplied through an 18-in. line. These are shown in Figs. 1, 3 and 6. The large volume of blast furnace gas required and its low Btu content require the use of especially designed blast furnace gas burners. These burners, developed by the Babcock and Wilcox Co., have proved highly satisfactory for burning blast furnace and coke oven gas, but their design is such that it is difficult to obtain satisfactory combustion of oil without the use of steam atomization. All oil burners, therefore, are of the steam atomizing type.

H_2S and Air Mixture Disposed of in Boiler Furnaces

An interesting complication in this plant arises from the necessity for disposing of large quantities of air mixed with hydrogen sulfide gas. This mixture is the waste product of a hydrogen sulfide removal plant which removes the excess H_2S from the coke oven gas. The mixture is not rich enough to be combustible, but contains sufficient H_2S to be obnoxious. Therefore, it is introduced into the boiler furnaces with the combustion air, and the H_2S is oxidized to water and sulfur dioxide.

To accomplish this automatically, the forced draft fans on the boilers are arranged to draw air from completely enclosed chambers or plenums, Fig. 6, into which the H_2S and air mixture is piped through suitable regulating valves, and also into which fresh air may flow through automatically controlled dampers. A pressure control device, connected to the hydrogen-sulfide-air mixture regulating valve and fresh air damper of each chamber, is arranged to maintain a slight negative pressure within the chamber at all times and

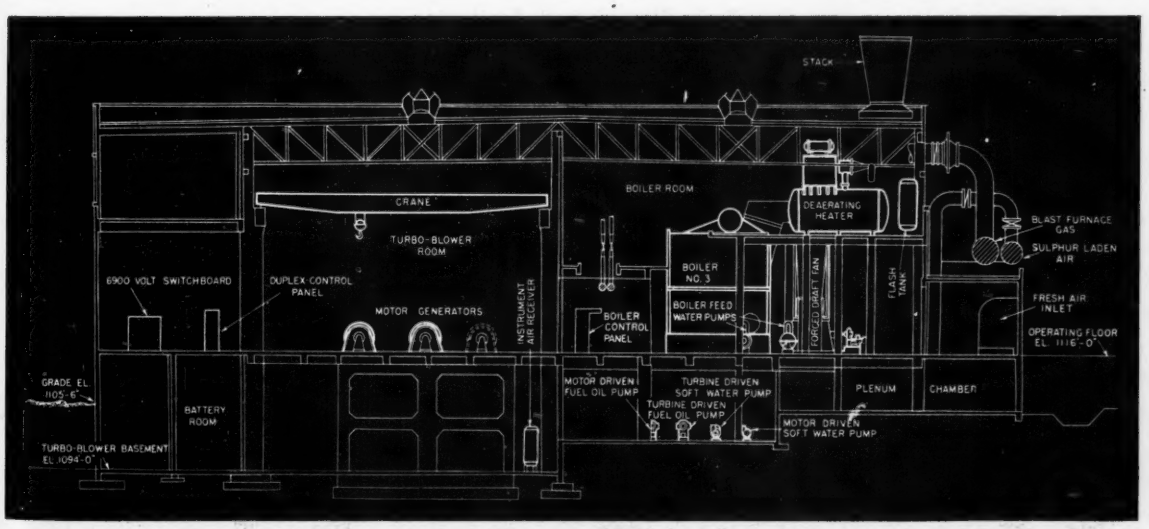

Fig. 6. Cross-section of Fontana power plant, looking west, showing motor-generators, boilers and auxiliaries

Major Equipment—Fontana Power Plant, Kaiser Co., Inc.

Steam Generating Units and Auxiliaries

Boilers: (Purchased and erected with accessories, from C. C. Moore & Co., Los Angeles.) (Boiler Settings erected by J. T. Thorpe & Sons, Inc., Los Angeles)
Number ..3
Make .....Babcock & Wilcox Co.
Type .....Integral Furnace
Capacity .Boilers No. 1 and No. 2—115,000 lb/hr each, with Blast Furnace Gas or Coke Oven Gas or Oil or any combination. Peak short time capacity with combination of coke oven gas and oil 160,000 lb/hr

Boiler No. 3 — 105,000 lb/hr with coke oven gas or oil or combination. 75,000 lb/hr with blast furnace gas

Design Pressure.475 psig.
Operating Pressure.400 psig at superheater outlet
Total steam temp. ...700 F
Air Preheaters .Tubular B & W
Air temperature to burners 530 F
Stack gas temperature 500 F
Superheaters .Babcox & Wilcox
Type: Convection, vertical loops, self-draining

Burners: Babcock & Wilcox combination multiport blast furnace and coke oven gas burners, each with three auxiliary steam atomizing oil guns
Number ..2 per boiler

Soot Blowers: Diamond Power Specialty Co.
Number ..6 per boiler plus 2 swing arm type for each air preheater

Gage Glasses: Diamond, Bi Color
Number ..1 per boiler

Safety Valves: Consolidated
Number ..Boilers No. 1 and No. 2—3 on drum, 1 on superheater

Blow-Off Valves: Babcock & Wilcox, angle type duplex sets

Forced Draft Fans: B. F. Sturtevant Co.
Number ..1 per boiler
Size .....No. 95 Turbovane fan, DWDI, class 4
Capacity ..231,000 lbs air per hr @ 11" S.P.
Speed ....1500 rpm max.
Max. hp ..140

Induced Draft Fans: B. F. Sturtevant Co.
Number ..1 per boiler
Size .....No. 1007 TVID, DWDI, class 6A
Capacity ..356,000 lb/hr flue gas @ 10.9" S.P.
Speed ....960 rpm max.
Max. hp....400

Fan Drives: Dual Drives. Each fan on Boiler No. 1 and No. 2 has turbine drive on one end of shaft through Rawson Coupling, and two-speed motor drive on other end. Fans on Boiler No. 3 have turbine drives only
F.D. Fan Turbines: Elliott No. 2 BY 160-hp geared units 3857/1450-rpm. 400 psig., 700 F inlet and 10 psig. back pressure.
I.D. Fan Turbines: Elliott No. 2 CY 400-hp geared units 4000/960-rpm. Same steam and exhaust conditions.
F.D. Motors: Westinghouse Type CS 200/50-hp 1500/750-rpm two-speed, single-winding, variable-torque, line-start induction motors, 440 v, three phase, 50 cycle, splash proof, 50 C temperature rise with class B insulation.
I.D. Fan Motors: Westinghouse Type CS 450/112-hp 1000/500-rpm two-speed, two-speed two winding, line-start induction motors, 2300 vs, 3 phase, 50 cycle, drip proof, 50 C temperature rise with class B insulation.

Stacks:
Number ..1 per boiler
Type .....Self-supporting steel, flared top
Diameter .6'-4"
Height.... Approximately 60 ft

Continuous Blow Down System: Cochrane Corp.
Consisting of: One 3'-6" dia x 6'-8" flash tank
One 90 sq ft heat exchanger
Blowdown flashed to 10-16 exhaust system.
Makeup water heated by exchanger.

Water Softeners: Permutit Co.
Type .....Zeo-Karb (Sodium Cycle)
Number of Units.2
Size, each.5'-6" dia x 5'-0" high
Max. Flow Rate ....200 gpm per unit
Softening Capacity between regenerations ...96000 gals per unit
Control ..Manual

Soft Water Storage Tank: Western Pipe & Steel Co.
Type .....Welded Steel Cone Roof
Size .....18' dia x 23'-6" high
Capacity .1000 bbl

Soft Water Booster Pumps: Ingersoll-Rand Co.
Number ..2
Type .....No. 3 CRVH
Capacity .350 gpm
Head .....150 ft
Speed ....2800 rpm
BHP 17½
Drives ....One Turbine—20 hp Elliott 2 AY
One Motor—Westinghouse CS-20 hp 440 v

Deaerating Feedwater Heater: Cochran Corp.
Number ..1
Capacity ..600,000 lb/hr max.
Working Pressure.5 psig to 15 psig
Storage 50,000 lb

Boiler Feed Pumps: Byron Jackson Co.
Number ..2
Type .....4 x 6—six stage OL Multiple
Capacity each ....440 gpm @ 550 psig discharge pressure
Speed ....2950 rpm
Brhp 203

Boiler Feed Pump Drivers:
No. 1.....Elliott Co. Type CY turbine
Brhp 250
Steam Conditions ...400 psig 700 F
Exhaust ..10 psig
No. 2 .....Westinghouse Type CS, 440 v, three phase motor 50 cycle
Brhp 250
Type .....50 C, splash proof, class B insulation

Fuel Oil Tank: Western Pipe & Steel Co.
Type .....15,000 bbl, welded, API, Cone Roof
Size .....60' dia x 30' high

Fuel Unloading Pump: National Transit Co.
Type .....7½ x 8½ x 10 duplex, steam pump 350 gpm

Burner High Pressure Fuel Pumps: Worthington Pump & Machinery Co.
Number ..2
Type .....3 GR Rotary Gear Pumps
Capacity, each ....75 gpm @ 350 psi

Fuel Pump Drives:
No. 1.....Elliott Type 2 BY turbine
Bhp 25
Rpm 2250/450
No. 2.....Westinghouse, Type CS, two speed motor
Bhp 25/12½
Rpm 450/230
Type .....440-vt, three phase, 50 cycle, two-speed single-winding, splash proof

Fuel Oil Heaters: Industrial Engineers
Number ..2
Type .....B-M-P design, tank type

Fuel Oil Heaters: Coen Co.
Number ..3
Type .....Multifilm, for burners

Fuel Oil Strainers:
A—At Pump Suctions: Fisher
Number ..1 for each pump
Type .....Cast Iron—Y Type
B—At Heater Outlet: Coen
Number ..1
Type .....Duplex—3" 300 lb

Turbo-Blowers and Auxiliaries

Turbo-Blowers: Ingersoll Rand Co.
Number ..2
Type .....Centrifugal Multistage type blower, direct connected to multistage condensing steam turbine
Capacity .100,000 cfm air at std. cond.
Discharge Pressure max. ...No. 1 unit 30 psig
No. 2 unit 35 psig
Speed ....2900 rpm max.
Size Air Inlet .....72"
Size Air Outlet ....42"
Brhp of drivers .No. 1—11600
No. 2—12800
Approximate dimensions: Length: 34'; Width: 12'—No. 1 unit; No. 2 unit slightly longer and heavier.
Approximate weight: 285,000 lb

Condensers: Ingersoll-Rand Co.
Number ..2 (1 per turbo-blower)
Type .....Two-pass, divided water box
Approximate surface .10,000 sq ft
Steam Inlet ....72"
Performance ....With 12000 gpm of 80 F water will maintain 28" vacuum (ref. to 30") at full load.
With one-half of water side out of service will carry full normal load at 26.95" vacuum (ref. to 30") with 6100 gpm circulated

Air Ejectors: Ingersoll-Rand Co.
Number ..2 per unit
Make .....
Type .....MS 30 Twin element two stage with surface inter and after coolers
Operating Steam Pressure .200 psig

Condensate Removal Pumps: Ingersoll-Rand Co. (Cameron)
Number ..2 per unit
Type .....No. 3 DHW—two stage
Capacity ..200 to 220 gpm
Head .....170' total head
Speed ....1450 rpm
Brhp 17

Drivers:
No. 1 .....General Electric Co. Type DS 114 steam turbine
Steam ....400 psig @ 700 F
Exhaust ..10 psig
No. 2 .....General Electric Co. Type K motor
Size .....20 hp, 440 v. three phase, 50 cycle

Atmospheric Relief Valves: Atwood & Morrill
Number ..1 per unit
Size .....18"

Inlet Air Filter Western Precipitation Corp.
Number ..1 for two units
Location ..In air inlet chamber above switchboard room. For removal of dust from turbo-blower inlet air
Type .....Electrostatic precipitator bank composed of Westinghouse Precipitron Cells. Constructed in sections and provided with semi-automatic washer for cleaning, washing, and servicing one section at a time without interruption of service of the bank.
Capacity ..Normal: 100,000 cfm free air
Size .....Approximately 25' x 13'-6"
Secondary emergency filter bank, metal wool type.
American Air Filter Co. Type AC-2.

Circulating Water Pumps: Ingersoll-Rand Co.
Number ..2
Type .....Single stage, 20", LFV horizontally split case
Capacity ..12300 gpm each
Head .....70 ft
Rpm 730
Brhp 247

Major Equipment—Fontana Power Plant, Kaiser Co., Inc. —Continued

Drivers for Circ. Pumps:
- No. 1 ..... Elliott 2 CY Turbine
- Brhp 247
- Speed ..... 2430/730 rpm
- Steam ..... 400 psig @ 700 F
- Exhaust .. 10 psig
- No. 2 ..... Westinghouse Motor
- Brhp 250
- Speed ..... 750 rpm
- Type ..... CS 440-v, three phase, 50 cycle, 50 C splash proof, class B insulation

Cooling Tower: Fluor Corp.
- Number .. 1. Additional towers to be installed for future expansion
- Type ..... 7 ND 12 Induced Draft Type
- Number of Cells .. 7
- Capacity .. 12000 gpm on at 90 F. off at 80 F with 70 F wet bulbs
- Fans ..... 7—each with 6 adjustable blades, 12′ dia.
- Fan Motors . 7—30 hp GE 440 v, splash proof
- Gear Boxes .. 7—Pacific Gear Works—right angle type
- Overall length of tower. 129 ft
- Overall width of tower. 38 ft.
- Overall height of tower. 27 ft

Control Equipment:
- Boiler Combustion Controls, Sulfur Laden Air Controls, Blower Constant Air Flow Controls ..... Askania Regulator Co.
- Boiler Feedwater Controls ..... Bailey Meter Co.
- Type ..... Three element
- Number ..... 1 per blr.
- Pressure Reducing Valves..., Temperature and Pressure Controls .... Taylor Instrument Co. & Fisher Governor Co.

Instruments:
- Boiler Meters, F.W. Meters and Boiler Level Recorders ..... Bailey Meter Co.
- Recording Flow, Pressure and Temperature Meters ..... Bristol
- Pressure Gages. Ashcroft
- Industrial Thermometers ... Tagliabue

Electrical Equipment

6900-V Switchboard: General Electric Co.
- Purpose .. Distribution center, also for control of transformers and of 2-1000 kw M.G. sets in power plant
- Type ..... Metal clad, remote controlled with magnetically operated air blast type circuit breakers, 500,000 kva interrupting capacity

2300-V Switchboard: General Electric Co.
- Purpose .. 2300-v distribution center, also for control of 2300-v power plant auxiliaries and transformers
- Type ..... Metal clad, remote controlled with magnetically operated air blast circuit breakers, 100,000 kva interrupting capacity

250-V D.C. Switchboard. General Electric Co.
- Purpose .. Control and distribution of 250-v dc output of motor generator sets
- Type ..... Dead front, live rear, cage enclosed, remote controlled

Duplex Control Panel: General Electric Co.
- Purpose .. Centralization of metering and control of three main boards above

440-V Switchboard: Square D Co.
- Purpose .. Control of 440-v plant auxiliaries
- Lighting Distribution Panel — Individual Lighting Cabinets, Misc. secondary sw. bds. ..... Square D Co.

Storage Battery: Exide Storage Battery Co.
- Purpose .. Switchboard control
- Type ..... EMC
- Number Cells 120
- Volts 240

Battery Charger: Electric Products Co.
- Type ..... Diverterpole
- Size ..... 10 kw

Power Transformers: Westinghouse Electric Corp.
- Number .. 12
- Type ..... Outdoor—substation type, oil filled, self-cooling.
- Sizes ..... Six—1000 kva 6900/2300 v, 50 cycle; Six— 333 kva 2300/460 v, 50 cycle

Lighting Transformers: Westinghouse
- Number .. 1
- Type ..... Outdoor substation type self-cooling
- Size ..... 150 kva — 460/230/115 v, 50 cycle

Motor Generators: Crocker Wheeler Div., Joshua Hendy Iron Wks.
- Number .. 2
- Size ..... 1000 kw
- Motors ... 1450 hp, 6900 v, synchronous
- Generators. 1000 kw, 250 v dc

Other Auxiliaries and Accessories

Instrument Air Compressors: Ingersoll Rand Co.
- Number .. 2
- Type .. . Two stage, type 15 B 40. Air cooled with air cooled intercooler
- Driver .... 15 hp G.E. Co. motor and V belt
- Discharge Pressure. 90 psig
- Capacity . 60 cfm

Instrument Air Receiver: Ingersoll-Rand Co.
- Number 1
- Size ..... 3′-0″ x 8′-0″—vertical

Utility Air Compressor: Fuller Co.
- For ..... Yard air service. This is one of several units distributed around the steel plant
- Number .. 1
- Type ..... Two stage rotary, water-cooled
- Discharge Pressure. 110 psig
- Capacity .. 1100 cfm
- Rpm 600
- Brhp 235
- Driver .... 250 hp, 440 v, three phase, 50 cycle. Synchronous Motor—Westinghouse, with direct driven exciter

Air Receiver: Fuller Co.
- Number .. 1
- Size ..... 4′ dia x 12′ long, horizontal

Miscellaneous Equipment:
- Crane ..... One—30 Ton—Whiting
- Expansion joints for 42″ air line. Badger
- Expansion joints for circulating water connection, rubber type ..... U. S. Rubber Co.
- Lighting fixtures. Holophane
- Gratings and stair treads ..... Reliance Steel Products Co.
- Building steel, upper side and end walls ..... Consolidated Steel Corp.
- Building siding and roof panels. H. H. Robertson Co.
- Building ventilators ..... Swartwout Co.
- Dampers for sulfur air and fresh air control to boilers ..... Allis Chalmers Mfg. Co.
- Piping — general and high pressure, prefabricated ..... Midwest Piping & Supply Co.
- Piping—large air and gas piping ..... Western Pipe and Steel Co.
- Piping—large water piping, coal tar lined and wrapped ..... Southern Pipe & Casing Co.
- Desuperheating equipment .... Swartwout Co.
- Spring loaded relief valves .... Atwood & Morrill
- 18″ and 42″ motor operated valves in air lines ..... Crane Co. and Chapman Valve Co.
- 42″ goggle valves for B.F. gas... W. H. Bailey Co.
- Butterfly valves—for gas throttling and control ..... R. S. Products Co.
- Pressure regulators and reducing valves ..... Fisher Governor Co
- Oil purifier and centrifuge ..... DeLaval Pacific Co.
- Insulation ..... Plant Rubber & Asbestos Co.
- Electric wire and cable, high voltage ..... General Cable Corp.

to regulate the amounts of sulfur-bearing air and fresh air so that the maximum available quantity of the sulfur-air mixture is used at all times and only sufficient fresh air allowed to enter to maintain the predetermined pressure in the chamber. One plenum chamber and set of controls is provided for each boiler and fan. This system is completely independent of the boiler combustion control equipment, which determines the amount of air taken from the plenum chamber by the forced draft fan.

The introduction of additional sulfur in the form of hydrogen sulfide into the boiler furnace creates another problem in that, at light loads, there is danger of corroding the air heater tubes. To obviate this difficulty, the air heaters on the boilers are provided with by-passes by means of which all, or any portion of, the cold air may be by-passed around the tubes so as to increase the tube temperatures. In order to determine what is going on, thermocouples are embedded in the walls of the air heater tubes at the coldest sections and temperature readings are available from the indicating instruments on the boiler control panels. An operating procedure is established whereby the tube temperatures are kept above specified minimum values.

All Electricity Purchased

At present no electric power is generated in the plant, all power for the steel mill being purchased from the local utility. Power is delivered to the main substation at approximately 69,000 v by the utility company. At this sub-station, it is transformed to 6900 v and distributed through a system of looped feeders to several other substations or distribution centers, from which it is distributed to the loads. Transformers at these substations reduce to 2300 v, 460 v, or 115/230 v to supply local demands. One of these substations is located at the power plant and the system is arranged so that the power plant may become the main power source and distribution center at some future time when power generating equipment is added. There is considerable demand for direct current in the rolling mills, the open hearths, and the blast furnace. This direct current is supplied by motor generator sets which are placed at convenient locations throughout the yard area. Two of these motor generator sets are located in the power plant building as shown in Figs 4 and 6 and provision has been made for the addition of the third set.

Turbine-Driven Auxiliaries Used

All plant auxiliaries are turbine-driven to insure continued service in case of power failure. This is important because any failure resulting in a shut-down of the air supply from the turbo-blowers will cause a shut down of the blast furnace. Failure of the water supply would cause very serious damage to the furnace. For that reason, standby steam-driven pumps are installed to supply general service water in case of a power failure. Auxiliary drive turbines operate with 400-psig 700-F steam and exhaust at about 10 psig. The exhaust is used for feedwater heating and deærating. To maintain a steam balance within the plant, many of the auxiliaries are also provided with electric motor drives.

In the case of pumps some units are turbine - driven and some are motor - driven. The boiler fans on Boilers No. 1 and No. 2 are provided with dual drives, each having a motor coupled to one end of the shaft and a turbine on the other. A Rawson coupling between turbine and fan allows the fan to run on the motor without revolving the turbine but allows the turbine to pick up instantly on power failure.

Emergency lighting in case of power interruption is provided by an automatic throw-over switch which connects essential circuits onto the battery as long as the power is off.

For reliability of operation and to facilitate the addition of future units, all high-pressure steam piping and feedwater piping is arranged in double header systems. The feedwater supply and makeup system and the deærating feedwater heater were originally installed with sufficient capacity to care for the ultimate plant. Only two high pressure boiler feed pumps are installed at present but provision is made for the installation of additional units as the required capacity demands.

Cooling towers are used for cooling of the condenser circulating water. The ultimate plant contemplates the use of 4 to 6 separate towers and a duplication of service lines to and from the towers. The original installation, however, included only one cooling tower and one set of circulating lines.

Major equipment such as turbo blowers, motor generators and switchgear, was specified and purchased by the Kaiser engineering staff. Bechtel-McCone-Parsons Corporation of Los Angeles made the detail design and were the general construction contractors.

SELECTING THE ELECTRIC MOTOR

By H. D. JAMES
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SELECTING the best type and size of electric motor for a given application is not difficult if a few simple facts are understood. Each type of motor has its own advantages and limitations, and some knowledge of these features is necessary. The available power is usually alternating current. A few applications require an adjustable speed d-c motor which can be operated from alternating current power by using either tube control or motor generator control. Either system can be made to regulate the speed accurately with variable load and to give a wide range of speed adjustment. A d-c shunt motor is used to drive the load and any compounding or other features are taken care of in the control. These systems are expensive and can be justified only when the application makes them necessary.

Most applications can be taken care of by a squirrel cage induction motor when properly selected. Some require an a-c induction motor with external resistance. The squirrel cage induction motor is the simplest type and should be used whenever it is practical for the application. Whenever possible a standard, listed motor should be selected.

The first step in applying a motor is to calculate the load in horsepower required to operate the machinery or apparatus to be driven.

The second step is to prepare a load-time curve or an operating schedule from which to obtain the average load. This is sometimes called the load factor. For example, a fan or pump may operate continuously or for a long enough time to bring the motor up to its balancing temperature. This application has a 100 per cent load factor. Elevators have a 25 per cent or less load factor. Cranes and hoists may have this same load factor. A planer or shaper is cutting only half of the time, but the return stroke consumes some power. A boring mill may do cutting continuously for long periods. All tools have idle periods when finished work is removed and new work is set up. Some of these tools may have a load factor of 30 to 40 per cent.

Load factors are tabulated to determine the total load for a manufacturing building; 25 per cent is probably high enough for average applications.

The load factor determines the heating when the motor is run long enough at light load to cool it. The motor torque may be the limiting factor that fixes its size. This torque must be calculated for the maximum load period. For a crane, it will be when the maximum load is being lifted; for an elevator the accelerating period with maximum load fixes the motor size. The speed-torque curve of the induction motor during acceleration can be adjusted by changing the resistance of its secondary up to the point of pull out torque for that motor frame. An increase in resistance increases the starting torque but also increases the full speed regulation from no load to full load.

Variable Speed Motors

A wound-secondary induction motor can have most of the secondary resistance external to its frame and adjustable when necessary to give various starting torques and reduced running speeds. These reduced speeds change if the load changes, and the motor is called a "variable speed" motor. This type is used for cranes and mine hoist and is found satisfactory for many other applications.

When the motor is quickly changed from full speed forward to full speed reverse, it is momentarily running at 200 per cent slip (zero speed is 100 per cent slip) and the reverse torque is usually less than the starting torque, depending on the secondary resistance. The squirrel cage motor has a fixed resistance which establishes both the starting and reversing torque. A low reverse torque may be desirable

to reduce the shock to the machinery when reversed.

Applications requiring more than one fixed running speed can use a gear box like an automobile, which will give four running speeds forward and four reverse by reversing the motor primary. The motor can be wound to give two or four fixed speeds by changing the number of poles in its primary. The two speed motor has a single winding arranged to connect in series and parallel sections to give a 2:1 pole ratio and a 2:1 speed. The four speed motor has two of these windings and the speeds are usually in multiples of 1-2-3-4. Motors have been built with two or three separate windings to give corresponding speeds, but these speeds must bear definite ratios to the number of primary slots in the iron core.

When a 2:1 speed motor is changed from the high to the low speed it operates momentarily at 100 per cent reverse slip, the same slip as when starting from rest and the torque is the same as at starting. When this type of motor is used for an elevator or hoist the torque at 200 per cent slip when reversed should always be sufficient to retard the load and prevent a runaway condition.

Two speed motors are often applied to fans and four speed motors to machine tools.

Flywheel Effect

Applications that require quick and frequent starting or reversing should use motors that have the least amount of flywheel effect. For a given speed the larger the rotor diameter, the greater the flywheel effect, as this increases as the square of the diameter and only directly as the width. A long, small diameter rotor is desirable for such applications. Trade publications usually give the data for calculating the flywheel effect for standard motors. Selecting a slower speed motor will usually reduce the stored energy, as this changes as the square of the speed and the speed decreases faster than the diameter. Special motors with small diameter rotors can be obtained if enough of them are used to keep the development expense within reasonable limits.

Squirrel cage induction motors are usually started at full voltage and take a momentary current inrush four to six times the full load current. The motor will accelerate to full speed in two to three seconds for most applications, but applications having a heavy inertia load such as some centrifugal devices may require a reduced voltage starter depending upon the time required to accelerate from rest to full speed. Applications requiring the start to be made under full load conditions must use a squirrel cage motor with a high resistance secondary or a wound secondary induction motor. The speed-torque curves should be examined and compared with the application requirements before selecting the motor.

The size of the squirrel cage motor that can be started at full voltage will be limited by the power supply. There should be no trouble in starting motors as large as 10 or 15 hp in an average manufacturing establishment. A check with the power company engineers will quickly fix this limit. Some power companies publish this limitation for different locations. After the motor has been started, it can be stopped by an excess overload and fail to restart. The maximum torque that the motor will deliver and continue to rotate must be less than its pull-out torque, which is published by the manufacturer as part of their standard data. This torque is given at the nameplate voltage and changes as the square of the voltage. For example, a ten per cent drop in line voltage decreases the motor torque nearly 20 per cent. Maintaining the line voltage when starting and running is very important and should be calculated for each branch circuit. The supply voltage is usually higher than the name plate voltage. A total drop of five per cent from no load to full load on any branch circuit is considered good practice. This allows 2 per cent drop for the branch circuit itself and 3 per cent for the primary and secondary feeders. Where low voltage cannot be avoided a larger motor may be necessary; calculations at the reduced voltage should be made to determine its size for starting and pull-out torques.

A variation of 10 per cent from the name plate voltage does not seriously affect the motor temperature, as the copper losses increase and the iron losses decrease in nearly the same proportion with a drop in voltage. An increase in voltage changes these losses in the opposite direction, but in the same proportion.

Effect of Phase Failure

When one phase of a three phase power circuit is open, the motor will not start from rest but will continue to run if the phase failure occurs after it reaches full speed. The rotating secondary causes the motor to operate as a phase converter, to supply power to the open phase. The lights will burn and other single phase devices will remain operative. The low voltage protection on the controller will not operate to stop the motor. At full load the two remaining power wires will have about 73 per cent overload. The controller overload protection is usually set above full motor load to permit successful starting and provide for short time overload periods; it may not operate to disconnect the motor from the line if the motor is running single phase, a little under full load. This condition may result in a motor burnout.

Steps should be taken to reduce the possibility of single phase operation. A fuse may open one circuit. It is therefore desirable to use three pole circuit breakers for feeder and branch circuit protection. If fuses are used they should be regularly inspected and kept in good operating condition.

In a power distribution system, provision must be made for many small motors which operate appliances, fans, etc. These motors are usually not over ½ hp and can be single phase and connected to the light distribution system. A good rule is to make all fractional horsepower motors single phase. They can be connected through a "twist lock" plug to a receptacle. This arrangement provides easy disconnecting means if the appliance is removed or is having work done upon it.

A plant using a large number of motors can sometimes standardize on a limited number of different sizes and speeds and purchase the motors of the same manufacturer. This reduces the stock of space parts for maintenance purposes and a few spare motors can be kept for emergency use. The steel mills have followed this practice for many years with success. Many organizations have not given this idea serious thought and accept any motor furnished with the equipment.

Engineers using motors should make a study of their characteristics from curves and other available data. Manufacturers publish much useful data on this subject. The duty cycle, speed regulation and other requirements the motor must meet should be analyzed before a selection is made.

Spontaneous Heating of Stored Coal

INFORMATION DESIGNED to help prevent the waste of millions of tons of coal annually through spontaneous heating while in storage is presented in a new Bureau of Mines report describing a series of laboratory tests at the Pittsburgh, Pa., Central Experiment Station.

The self-heating tendencies of 46 samples of coal, varying in rank from low-volatile bituminous to lignite, were demonstrated and measured by means of a specially-developed device and the results reported in detail in the publication recently issued by the Bureau. The source and analysis of the samples, relative spontaneous-heating tendencies, and the effect of several variables are given.

To store coal properly for indefinite periods, something must be known about its tendency to heat spontaneously in storage. Spontaneous heating is caused by the reaction of oxygen from the atmosphere with the coal, resulting in the liberation of heat which is known as low-temperature oxidation. Loss of coal from oxidation, fires and other similar causes runs into millions of tons every year.

A copy of the publication, Technical Paper 681, "Relative Spontaneous Heating Tendencies of Coal," by J. L. Elder, L. D. Schmidt, W. A. Steiner and J. D. Davis, may be obtained from the Superintendent of Documents, Government Printing Office, Washington 25, D. C., for 10 cents.

The Coal Atomizer—

A New Method of Pulverizing and Drying Coal

By

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THE INCREASING USE of pulverization as a means of preparing coal for use in gasification, as well as combustion, has resulted in the development of many new methods of powdering coal. The influence of moisture upon the performance of feeders, pulverizers, and furnaces has also been the subject of much study. During the past two years, the Institute of Gas Technology has been developing a process for simultaneously pulverizing and drying crushed coal. Because of the nature of the process which brings about these two effects, the term "coal atomizer" has been applied to the apparatus.

Most of the pulverizers currently in industrial use operate on the principle utilized in the primitive grain mill. Coal is ground between two heavy metal members by an externally powered drive shaft. The ball mill produces much the same effect, although the balls are caused to fall by rotating the casing, which houses them and the coal. Such pulverizing equipment is very widely used because of its power economy and its ability to produce a very fine product. Most of these mills, however, are dependent to some extent upon the moisture in the feed, and the grindability of the incoming coal also affects the throughput and the power requirement.

The increase in the use of pulverization as a process in chemical engineering has encouraged the development of a number of mills which use various principles related to the forces set up by flowing streams of superheated steam or other gases. Among the oldest of these devices are the various impact mills, in which coal is picked up at atmospheric pressure by a rapidly moving stream of gas, and thrown against a target, which shatters the coal. More recently, several mills have been developed which cause pulverization to occur because of attrition among particles which are moving at different rates of speeds in a fluid vortex. Extremely fine pulverization can be accomplished by these methods, although the energy consumption is usually higher than with a mechanical mill.

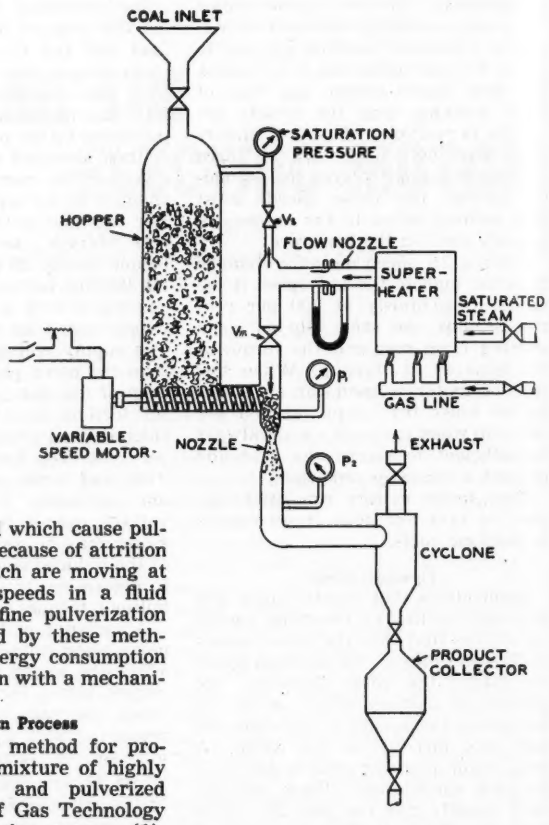


Fig. 1. Schematic diagram of the coal atomizer

The Explosion Process

In seeking a new method for producing an intimate mixture of highly superheated steam and pulverized coal, the Institute of Gas Technology turned to the explosion process (1), which, in the form of batch processes, has been used for many years in the wood pulp and cereal industries. Patents were issued as far back as 1870 on processes for cooking fibrous materials with water under pressure, and causing the resulting pulp to be disintegrated by allowing it to discharge at intervals into a region of low pressure (2). The most commonly encountered products of this explosion process are the well-known varieties of "puffed" cereals, which are produced by charging them into a pressure vessel, introducing low pressure steam, and then releasing that pressure rapidly. These processes are intermittent, since the vessel must be recharged before each application, and the product is often described as "shot from guns."

A number of investigators have studied the possibility of comminuting minerals by some version of this internal explosion process. Dean and Gross, and their associates, of the U. S. Bureau of Mines, have carried out extensive investigations (3) on the possibilities of crushing ore by a version of this process. Dr. F. W. Godwin, of the Armour Research Foundation, and V. G. Leach, of the Peabody Coal Co., found in 1938 that coal could be broken and pulverized to some extent by causing it to be saturated in a cylinder with steam under high pressure (1500 psi), and then releasing that pressure as rapidly as possible. T. J. Poulter (5) has found that materials such as glass and fused quartz, which appear to be quite impermeable, can actually be penetrated by liquids such as ether or alcohol if the pressure is raised to extremely high values, such as 30,000 atmospheres. If the pressure is then rapidly released, the glass or quartz rod is shattered into a fine powder.

Disintegration of Permeable Materials

In searching for a new and practical method of pulverizing coal with highly superheated steam, it appeared, from the investigations mentioned above, that the disintegration of permeable materials was caused by releasing the external pressure, so that the fluids trapped in the pores of the material, in trying to expand, would shatter the

Device based on explosion principle used in making "puffed" cereals . . . Coal pulverization in a nozzle . . . No moving parts in pulverizer . . . Surface factor in pulverizing . . . Influence of steam pressure, re-cycling of product and other factors . . . Coal atomizer dries coal; makes possible drying and pulverizing of lignite as easily as coal . . . Air can be used in coal atomizer as well as steam

material. Because of the well-known fact (6) that coal is relatively porous, this extremely important material appeared to be quite well suited to this process.

Both high pressure and intermittent operation stood in the way of development of the explosion process, and it was believed that these two disadvantages could be overcome at one time if use were made of a nozzle as a means of reducing the pressure almost instantly. The rate of change of pressure with time was shown by some of the earlier investigators to be a controlling factor, and so the writers concluded that, if the time required to reduce the pressure could be brought to a minimum, the high pressure used in previous work could be replaced by a much more moderate pressure.

Details of the "Coal Atomizer"

The apparatus by which this theory was proved to be correct is shown in Fig. 1. The essential parts of the apparatus are a hopper, where crushed coal can be stored under pressure; a means of introducing this coal at a controlled rate into the upstream side of a nozzle through which steam or some other compressed gas is flowing; and the nozzle itself, which, because of the pressure range employed, was made first to converge to a throat and then to diverge to an appropriate size. A cyclone separator was provided so that the product could be collected and analyzed, while the exhaust steam was allowed to go to the atmosphere or to a condenser.

In order to be able to determine the effect of the principal variables, such as steam temperatures and pressures, and the ratio of steam flow to solid flow, a flow nozzle was installed, and the necessary pressure gages were used, as shown in Fig. 1. A simple superheater was also employed, both for the purpose of eliminating moisture from the steam and to provide a variable initial steam temperature. Control of the coal feed rate was accomplished by varying the speed of the feeder motor, while continuity of operation was contemplated through the use of locks to admit coal from an atmospheric pressure inlet to the hopper. The product collector was heated to avoid the condensation of steam, and to facilitate the removal of the product. The first nozzle to be employed was made of Pyrex glass, since a suitable nozzle was available from previous experiments on the flow of saturated steam through transparent nozzles.

Table showing values of surface factor for various sizes of pulverized material, using standard Tyler sieves

Through	On	Surface Factor
16	30	37.2
30	60	75.9
60	100	137.7
100	200	258.7
—	-200 and finer	500.0

Operation of Unit

In the first operation of the unit, a charge of crushed coal was fed into the hopper. The coal was sieved through a 16 mesh screen, in order to avoid any possibility of clogging the ⅛-in. throat of the nozzle. Long experience in the sand blast art has shown that, if the feed is sized so that the nozzle diameter is greater than three particle diameters, the nozzle will not clog.

When the steam, flowing through the transparent nozzle appeared to be dry, the saturation valve Vs, Fig. 1, was opened, so that full line pressure was applied to the coal in the hopper. After allowing a few minutes for the steam to permeate the coal, the motor was started, and coal could be seen to flow with the steam into the nozzle. When the product was removed from the collector, it was apparent that the passage through the nozzle had caused the coal to be reduced in size from the — 16 + 30 mesh feed to a finely pulverized powder, with the analysis shown in Fig. 2. Since the original theory of pulverization by continuous flow of crushed coal through a nozzle was proved by this first test, a number of additional experiments were performed in order to determine the effect of the obvious variables.

One important question was answered by a temporary modification of the apparatus, as shown in Fig. 3. It was suggested that the pulverization might be due to impact of the coal flowing from the nozzle against the elbow in the line leading to the cyclone. This uncertainty was eliminated by causing the nozzle to discharge directly into a large bag filter, which was so arranged that impact was virtually eliminated. A second test was performed with the bag filter placed between the elbow and the cyclone. These tests demonstrated that the pulverization due to impact

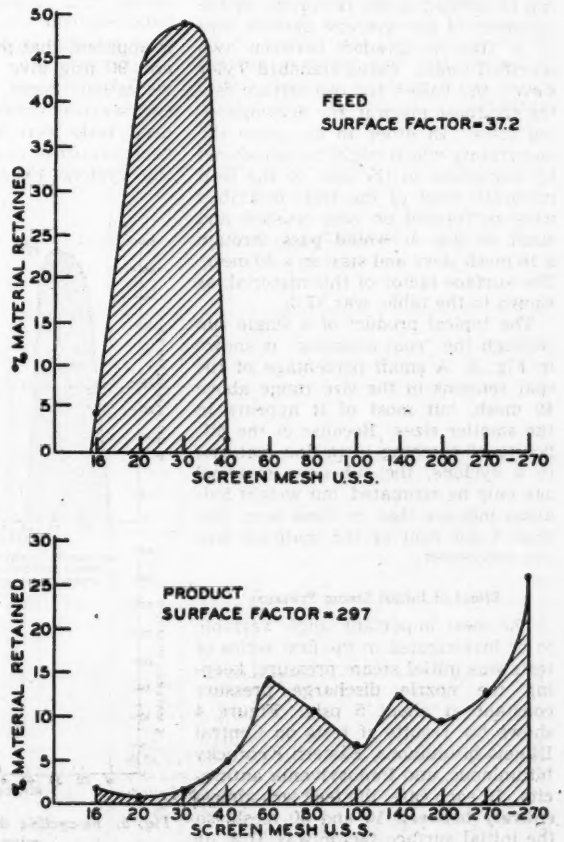

FEED
SURFACE FACTOR = 37.2
% MATERIAL RETAINED
SCREEN MESH U.S.S.
16 20 30 40 60 80 100 140 200 270 -270
PRODUCT
SURFACE FACTOR = 297
% MATERIAL RETAINED
SCREEN MESH U.S.S.
16 20 30 40 60 80 100 140 200 270 -270

Fig. 2. Pulverization of Kentucky bituminous coal in the coal atomizer

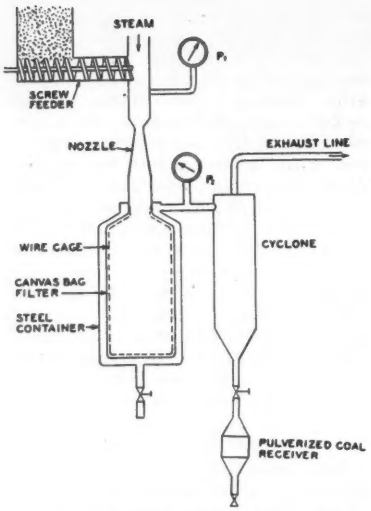


Fig. 3. Modification of coal atomizer to determine effect of impact

was only a small part of the observed effect, and at least 85 per cent of the pulverization took place in the nozzle itself.

Analysis of Performance

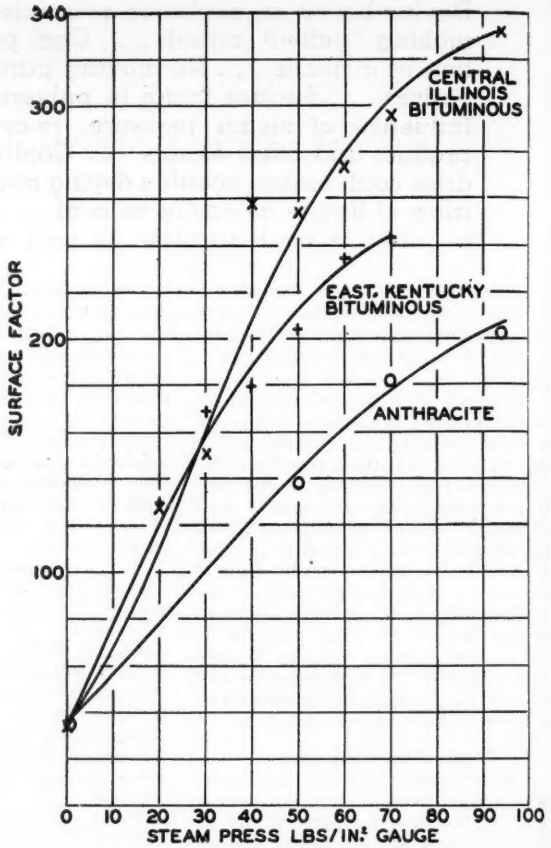
Statement of the performance of a pulverizer depends upon some adequate means of defining the original and final size of the particles. The term "surface factor" is widely used for this purpose. The surface factor can be defined as the reciprocal of the diameter of the average particle size of a fraction graded between two specified limits. Using standard Tyler sieves, the values for the surface factor are those given in the accompanying table. In order to eliminate the uncertainty which might be introduced by variations in the size of the feed material, most of the tests described were performed on coal crushed and sized so that it would pass through a 16 mesh sieve and stay on a 30 mesh. The surface factor of this material, as shown in the table, was 37.2.

The typical product of a single run through the "coal atomizer" is shown in Fig. 2. A small percentage of the coal remains in the size range above 40 mesh, but most of it appears in the smaller sizes. Because of the difficulty of catching ultra-fine material in a cyclone, the sub-sieve material can only be estimated, but weight balances indicate that, in these tests, less than 1 per cent of the material was not recovered.

Effect of Initial Steam Pressure

The most important single variable to be investigated in the first series of tests was initial steam pressure, keeping the nozzle discharge pressure constant at about 5 psig. Figure 4 shows the results of tests on Central Illinois bituminous, Eastern Kentucky bituminous, and Pennsylvania anthracite. In each case, the feed was almost entirely between 16 and 30 mesh, so the initial surface factor was 37.2. It

Fig. 4. Surface factor vs steam pressure



is apparent that pressures between 60 and 90 psig give quite effective pulverization. Since there are evidently two ways of increasing the pressure drop, tests were run with a reduced back pressure, caused by discharging the cyclone exhaust into a surface condenser. An appreciable increase in surface factor was noted, but the increased difficulty of operation, due to the necessity of removing the product against pressure, indicates that this method is not too promising.

The steam supply available during these tests had an upper pressure of 95 psig, but equipment is now being installed which will enable tests to be

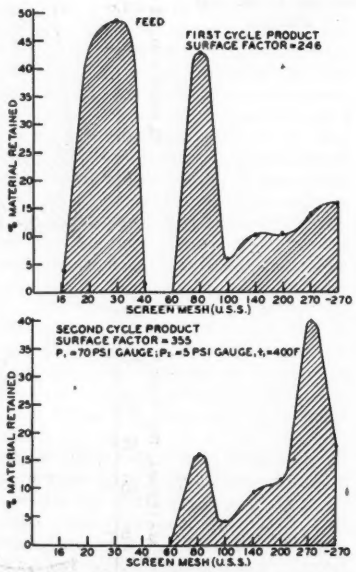

FEED
FIRST CYCLE PRODUCT
SURFACE FACTOR = 246
% MATERIAL RETAINED
SCREEN MESH (U.S.S.)
SECOND CYCLE PRODUCT
SURFACE FACTOR = 355
P_1 = 70 PSI GAUGE; P_2 = 5 PSI GAUGE, t = 400°F
% MATERIAL RETAINED
SCREEN MESH (U.S.S.)

Fig. 5. Re-cycling data for Kentucky bituminous coal

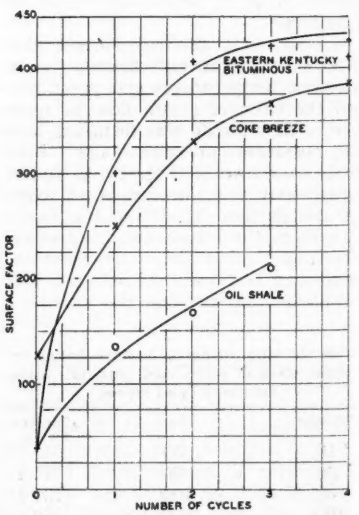


Fig. 6. Effect of re-cycling on various materials

run at pressures up to 1,000 psi. Within the range of pressures used during these tests, it appears that there is a definite increase in the fineness of pulverization as initial pressure goes up. The economical upper pressure will probably depend upon what steam generating facilities are available in each particular installation. Steam temperature was investigated over a reasonably wide range. There seemed to be little, if any, measurable effect of increasing the steam temperature from a few degrees above saturation up to several hundred degrees of superheat.

Re-cycling the Product

The effect of re-cycling the product from a first pulverization was investigated, and the results are shown in Figs. 5 and 6. Using a Kentucky bituminous coal, the product of the first run through the apparatus contained about 45 per cent of material which stayed on the 80 mesh screen. Approximately 30 per cent of the material was finer than 200 mesh. By re-cycling all of the product, the 80-mesh material was reduced to about 15 per cent, while approximately 55 per cent passed through the 200-mesh screen. The increase in surface factor for the Eastern Kentucky coal, as well as for coke breeze and oil shale, is shown on Fig. 6. The general effect of re-cycling appears to be a reduction of the + 100 mesh material, and an increase in the — 200 + 325 mesh material. This method of pulverization appears to be characterized by a relative freedom from ultra-fine material.

Ratio of Steam Flow to Coal Flow

From an energy point of view, one of the most important variables in the process is the ratio of steam flow to coal flow. The coal atomizer is particularly designed to allow this variable to be investigated, since the ratio of steam to coal can be varied by changing the speed of the screw feeder. Figure 7 shows the result of a series of tests on an Illinois bituminous coal, crushed to pass through a 16-mesh sieve, but with the fines retained in the feed. The surface factor of the feed material averaged 115, while the surface factor of the product, for a single pass through the pulverizer, seemed to reach a maximum of almost 240 at a steam-to-coal ratio of 0.725 lb per lb. The rate of coal feed in this test was 224 lb per hour. As the rate of coal feed was increased, with the upstream steam pressure kept constant at approximately 100 psia, and the temperature at about 620F, the fineness of pulverization decreased.

A possible explanation for this decrease in pulverization is found in the lower average velocity of the coal particles, and hence the lower rate of pressure change, which must exist as the coal feed is increased. The acceleration of the coal through the nozzle is obtained at the expense of steam velocity, and it is evident that the

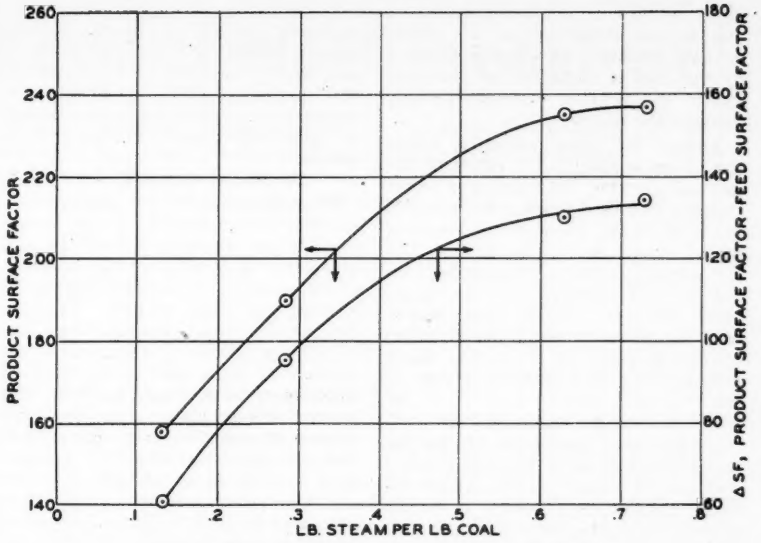


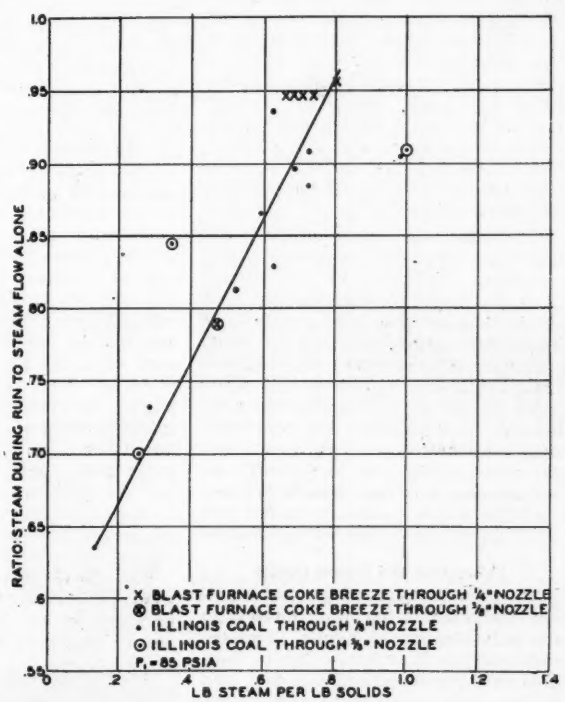
Fig. 7. Effect of steam-to-coal ratio on pulverization

average velocity of both coal and steam should decrease with decreasing ratio of steam to coal. This explanation is consistent with the original theory that the pulverization is dependent upon the time rate of change of pressure.

Data for Coal Atomizer Design

The design of a coal atomizer can be accomplished with the aid of Figs. 4, 7 and 8. The pressure drop necessary to achieve a given surface factor with a particular coal can be estimated from Fig. 4. The quantity of steam required can be obtained from Fig. 7. Figure 8 shows the effect upon the flow of steam through a nozzle, of increasing the amount of solids fed during a given period of time. When the ratio of steam flow to solid flow is 1.0 or larger, the presence of the granular solid material apparently has almost no effect upon the steam flow. When the rate of solid flow is increased, so that the ratio of steam to solids becomes approximately 0.5, the steam flow will be between 80 per cent and 85 per cent of the amount which would flow through the nozzle without carrying any solid material. This reduction in steam flow as the solid feed is increased is apparently

Fig. 8. Effect of addition of solids on flow of steam



due to the reduction in the steam velocity, because the volume occupied by the coal is negligible in comparison to the volume of steam passing through the nozzle.

Among the other variables which have been studied is the effect of initial particle size. In running a series of tests with coal passing screen sizes of 10, 16, 30 and 40 mesh, representing initial surface factors from 37 to 205, the surface factor of the product increased only about 15 per cent. It appears, therefore, that the most important factors controlling pulverization by this process are the initial steam pressure and the ratio of steam to coal.

How the Atomizer Dries Coal

In the very first tests of the apparatus, it was noted that the product was quite dry, and this drying appears to be characteristic of the operation of the coal atomizer. Actually, the atomizer is very similar in its operation to the throttling calorimeter, since the energy released in the passage of the steam through the nozzle is reconverted into heat. For example, coal with an initial moisture content of 7.3 per cent was discharged with a moisture content of 1.5 per cent. The only adverse effect of high moisture content of the feed material is the increase in feeding difficulties. The moisture content of the discharged product is usually less than 1 per cent, despite a wide variation of initial moisture content and initial steam temperature.

The drying effect can be predicted if the atomization is considered to be a throttling process, in which the quality of the initial mixture is the average of the superheated steam, plus the moisture brought in with the coal. The reduction in temperature of the exhaust steam below the temperature of the incoming steam appears to be just about enough to account for the heating of the coal up to the steam temperature and the evaporation of the moisture in the coal. Very little energy seems to be required for the actual pulverization.

The time required to saturate the coal was a matter of considerable uncertainty. In many of the earlier tests, the time of residence of the feed in the hopper was kept constant at 30 minutes. However, in later tests, the time of residence was reduced until finally the apparatus was operated as fast as the valves could be opened. It may safely be concluded that the penetration of the steam into the pores of the coal is virtually instantaneous, and coal can be pulverized just as fast as it can be fed into the high pressure side of the nozzle.

Pulverizing and Drying Lignite

The drying ability of the coal atomizer immediately led to an interest in the pulverization of lignite. Test results indicate that lignite can be handled as easily as bituminous coal, and it has been possible to reduce the moisture content of North Dakota lignite during this process from 37 per cent in the feed to 4 per cent in the discharge. The possibilities of simultaneous drying and pulverization of lignite will receive further investigation.

No Moving Parts in Atomizer

The simplicity of the apparatus is particularly interesting. Aside from a small screw conveyor to feed the coal at a controlled rate from the pressure chamber into the flowing steam, no moving parts are needed. Wear on the nozzle itself depends upon the solid being atomized. Bituminous coal appears to have only a slight effect upon even mild steel, whereas coke breeze brings about a considerable extent of abrasion in a fairly short time. In future installations, the nozzle will be made of boron carbide, which has been used for such purposes in the sand blast art. If a right angle bend is placed a short distance beyond the nozzle, wear is encountered when an extremely abrasive material, such as coke breeze, is pulverized. There are several well-known devices for minimizing such abrasion, including the replacing of the elbow by a tee.

In adapting the atomizer to commercial uses, one of the most important problems is putting the coal under pressure. Again turning to the pressure blast field, the use of lock hoppers appears to be indicated. Other devices are under development, which may lead to a continuous method of pressurizing the coal.

In the tests reported in the present paper, there was no noticeable change in the volatile content of the coal. The highest temperature used in the tests was about 650 F, which is below that required to bring about appreciable devolatilization. When the ash is homogeneously distributed throughout the coal, there is very little evidence of selective pulverization.

Applications of the Coal Atomizer

The usefulness of the coal atomizer is primarily a matter of the economics of individual installations. There seems to be no limiting size inherent in the process, and larger coal flows can be obtained very simply by increasing the size of the nozzle. The exhaust steam comes out superheated, and can be used wherever the presence of a trace of coal dust is not harmful. Bag filters could be employed to remove even those very small quantities of fines which pass the cyclone. In such processes as gas generation, where the steam is needed for the process, there would be no necessity of separating the coal from the steam, and the additional cost of pulverization becomes very small.

For open cycle gas turbine use,* where the coal must be put under pressure in any event, the coal atomizer appears to have particular advantages. It is contemplated that the air needed for pulverization will be obtained by abstracting a small quantity of compressed air from the main compressor discharge and raising its pressure to the necessary value by means of a small auxiliary compressor. The air thus utilized for pulverization automatically becomes the primary air, and conveys the fuel into the combustor. It then proceeds through the turbine in the usual manner. The energy required for pulverization thus becomes only that necessary to operate the auxiliary compressor.

*The Coal-Burning Gas Turbine for Locomotive Use, by John I. Yellott; POWER PLANT ENGINEERING, August, 1945.

Use of Air in the Coal Atomizer for Pulverizing

Tests conducted at The Johns Hopkins University for the Locomotive Development Committee have shown that air is an excellent pulverizing medium. No difficulty has been encountered from premature ignition of the coal, and the absence of moisture in the air simplifies the feeding problem, and eliminates the necessity of insulating the components of the atomizer. It is apparently unnecessary to heat the air, because air taken from a large surge tank after an intercooled compressor, entering the nozzle at 110 F, does an excellent job of pulverization.

The foregoing report has been prepared primarily to present to the engineering world some of the fundamental facts concerning a method of pulverization and drying which will undoubtedly have some specific fields of usefulness. In the preparation of pulverized coke breeze, for example, the coal atomizer is not troubled with prohibitive abrasion. The relative scarcity of ultra-fine fragments from the product is particularly valuable in certain catalytic processes. Further development of the atomizer is being carried on both by the Institute of Gas Technology and by the Locomotive Development Committee of Bituminous Coal Research, Inc. The authors wish to acknowledge the contributions made during the experimental program by R. T. Griffiths, T. J. Kenny, F. C. Foster, and Reid Howe, of the Coal and Gasification Section, Institute of Gas Technology.

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Care and Upkeep of Heat Insulation

Heat and financial losses from uninsulated hot surfaces . . . Defects in covering reduce insulation efficiency . . . Increased temperatures call for additional insulation . . . External appearance of old covering may hide undesirable conditions . . . Pointers on insulation inspection . . . Recommended thickness of insulation

By **UTLEY W. SMITH,** Manager, Magnesia Insulation Manufacturers Association

MODERN HEAT-SAVING insulations require little babying or "loving care" once they are started on their heat-saving way in industry. 85% Magnesia, for example, has a record in many installations of even outlasting the pipe lines and some of the equipment which it covers. But in general in this advanced era of dietetics, schedules, vitamins and—yes, even "changes"—it is also wise for all industry to examine approved methods in the care and feeding of the older insulations which, over the years, have contributed so vitally to production efficiency and year-end profits.

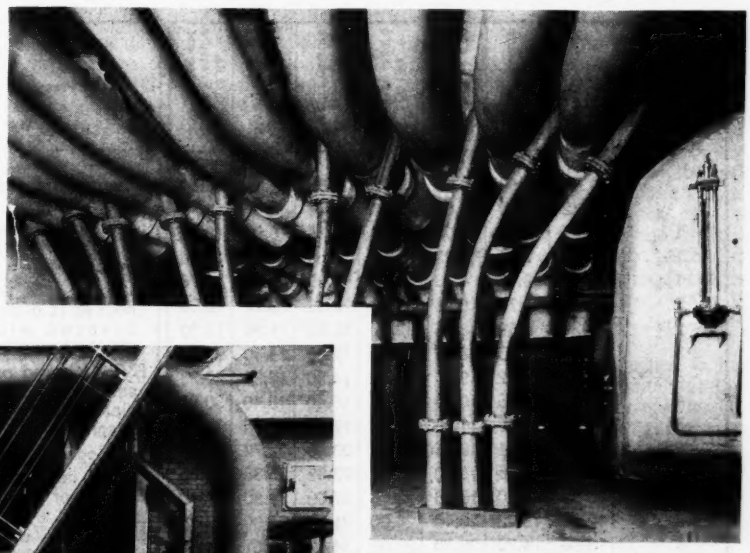
So general has been industry's appreciation of the job which heat insulation performs that today there is little heat-producing or heat transmission equipment totally without insulation. Heat losses from completely bare hot pipes or equipment mount into tremendous totals. The heat loss from 1000 sq ft of exposed surface at 100 psi steam pressure represents over 300 tons of coal annually, and even a pair of bare, standard, 10-in. flanges on a 150 psi steam line can cost more than one ton of coal a year. Translated into dollars and cents, it has not been difficult, therefore, for individual manufacturing institutions to appreciate the economies of heat insulation in putting a stop to such unnecessary heat waste.

But the mere fact that these efficient overcoats have been put on pipes and equipment does not always mean that the baby's health is protected until kingdom come. "Covered" pipes can also lose heat, generally due to changes in steam pressures and other factors which have made their entrance since the original insulation was installed. Routine maintenance inspections will reveal the need for repainting, repair of surfaces damaged in service, tightening of wires, bands and jackets and necessary weatherproofing, but to insure full insulation economy more than a casual surface examination is advisable. This is particularly true today as industry enters the reconversion era, for maximum production economies now will aid the faster production of civilian goods, and reflect advantageously on profits.

Heat Losses Increase with Temperatures

Look first at the record of steam pressures and process temperatures since the original insulation was installed. There has been a trend in industry over the years to increase both steam pressures and process temperatures on existing piping and equipment and, in some instance, this has been done without compensating attention to additional insulation requirements. In such cases the thermal efficiencies of the insulation, at a maximum for the conditions presented at the time of installation, may be uneconomically low for current demands, and valuable heat is being lost without giving evidence which might be revealed by a routine surface examination.

It is also possible that the canvas jacket which covers the insulation may be a too-competent disguise for conditions which need correction underneath. Sometimes some types of insulations, due to changed conditions or increased power demands within a plant, have shrunk or loosened in service. Or they may have suffered from chemical fumes and moisture, as well as new temperatures beyond the safe limits for which they were



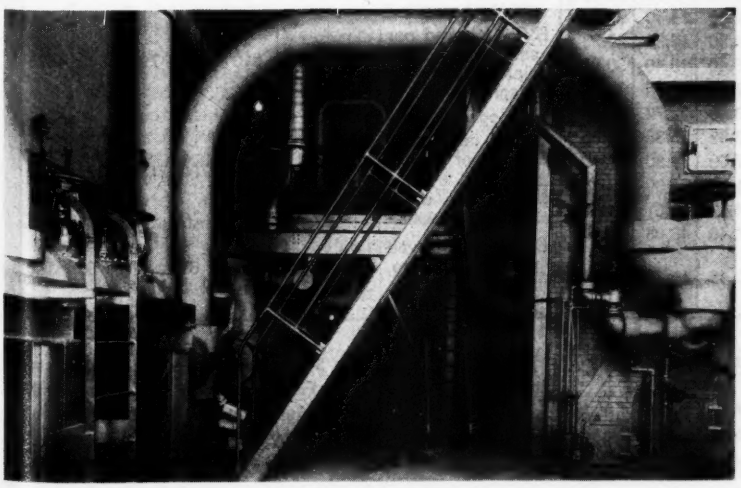


Fig. 1. (Left) Insulation on those pipes and other equipment near the floor is due to take a beating—better keep an eye on it

Fig. 2. (Above) These circulating tubes are subject to stress and strain, expansion and contraction—watch out for loosening of the covering

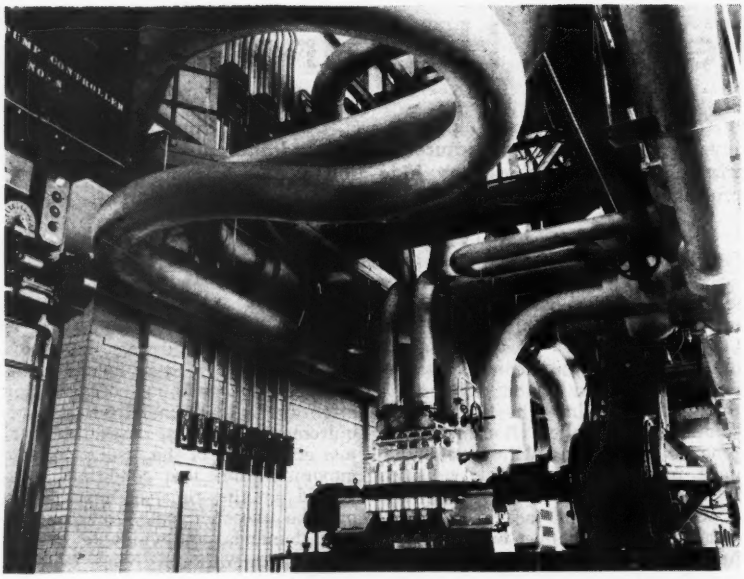


Fig. 3. This looks like an excellent job of pipe covering — but those bare flanges aren't doing the coal pile any good

originally applied. Such conditions sometimes are effectively concealed by the outer canvas covering, and investigations by competent technical experts are advisable to determine the corrections necessary. In the 85% Magnesia industry, manufacturers and their distributors and approved contractors have staffs of technical experts for such work and many cases are on record where the cost of the recommended changes are amazingly low in relation to the substantial savings effected.

Inspection of Insulation

The procedure in the 85% Magnesia field is, perhaps, typical of good modern insulation teamwork between industry and insulation producers. This is how it works: Technical insulation experts employed by the individual producers of 85% Magnesia and their distributors and approved contractors respond to requests for an investigation of the efficiency of the insulation in any plant. A thorough inspection is made of all insulated piping and equipment. Necessary additional data on general heating practice is obtained, and all of the facts are submitted to careful analysis. Sometimes such surveys are merely confirmation that the insulation is satisfactory, and entirely adequate to current demands. In other cases, they reveal inefficiencies which are costing sums of money not even suspected; and also the need for additional insulation on piping or equipment not previously protected. After the facts are analyzed, detailed recommendations are made for specific equipment, together with estimates of costs and possible savings. No obligation is involved in such investigations; the recommendations may be filed away and forgotten,

Table I. Monthly saving in dollars and cents by use of 85% Magnesia pipe covering, per 100 lineal feet of steam pipe, standard thickness

Size of Pipe	5 Lbs. Steam Pressure	10 Lbs. Steam Pressure	50 Lbs. Steam Pressure	100 Lbs. Steam Pressure	150 Lbs. Steam Pressure	200 Lbs. Steam Pressure	200 Lbs. Steam Pressure 100° Superheat
½	$1.44	$1.58	$2.20	$3.28	$3.66	$4.11	$6.80
¾	1.72	1.89	2.87	3.70	4.26	4.89	8.03
1	2.11	2.30	3.56	4.80	5.35	6.04	10.00
1¼	2.52	2.74	4.22	5.52	6.50	7.25	12.20
1½	2.86	3.10	4.73	6.14	7.29	8.17	13.70
2	3.53	3.74	5.86	7.63	8.93	10.11	16.80
2½	4.25	4.39	6.95	9.07	10.55	11.90	19.90
3	5.00	5.33	8.30	10.90	12.60	14.30	23.82
3½	5.72	6.22	9.60	12.40	14.40	16.32	27.23
4	6.50	7.06	10.60	14.05	16.40	18.40	30.85
4½	7.30	7.69	11.80	15.35	17.92	20.25	34.00
5	7.97	8.64	13.16	17.20	20.00	22.72	38.00
6	9.36	10.15	15.60	20.38	23.82	26.88	44.90
7	10.90	11.70	18.38	23.68	27.60	30.80	52.00
8	12.26	13.22	20.40	26.60	31.20	34.90	58.55
9	13.80	14.70	22.70	29.00	34.52	38.61	64.80
10	15.08	16.33	25.00	32.70	38.40	43.08	72.40
100 sq. ft. 1¼" thick flat surface	5.26	5.67	8.80	11.50	13.48	15.12	25.44

These savings are based on pipes carrying steam 24 hours per day and 30 days per month.

Coal is figured at $5.00 per ton, delivered, with 14,000 B. T. U. per pound. Boiler efficiency is calculated at 70 per cent.

Table II. Amount of coal saved by 85% Magnesia pipe covering, standard thickness. Coal figures at 14,000 Btu per lb. boiler efficiency 70 per cent

Steam Pressure	Saturated 5 Lbs.	Saturated 10 Lbs.	Saturated 50 Lbs.	Saturated 100 Lbs.	Saturated 150 Lbs.	Saturated 200 Lbs.	200 Lbs. Pressure with 100° Superheat
Steam Temp. Deg. Fahr.	228	240	298	338	366	388	488
B. T. U. loss per hour sq. ft. bare pipe.	367	409	625	802	937	1058	1735
B. T. U. loss per hour sq. ft. of pipe covered with "85% Magnesia."	69	76	105	126	142	153	210
B. T. U. saved per sq. ft. by covering pipe with "85% Magnesia."	298	333	510	676	795	905	1525
Tons (2240 lbs.) coal saved per 10,000 sq. ft. per year of 8,760 hrs. by pipe covered with "85% Magnesia."	1190	1330	2080	2700	3180	3620	5650
Cars of coal saved per year, as above, at 40 tons per car.	30	36	52	68	80	90	140

This table is based on 3-inch pipe. The savings increase with the diameter of pipe. For flat surfaces add 27 per cent. to above figures. Still greater economy will be shown at pressures 100 lbs. and upwards by the use of greater thickness of 85% Magnesia.

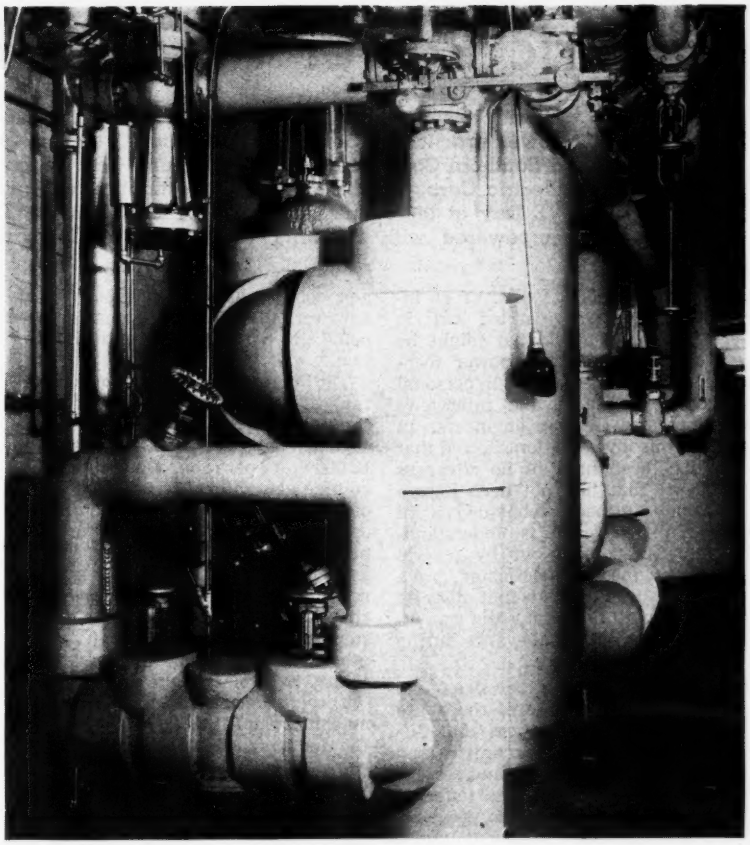


Fig. 4. Projecting flange insulation such as shown here is easily damaged and needed repairs should have prompt attention

they may be modified, or accepted in full.

In the insulation of power plant equipment, 85% Magnesia is a good example for illustration of standard practices, for it is the insulation which has been most widely used over long periods of time, and for many years has set thermal insulation standards whether used alone for temperatures up to 600 F, or with an underlayer of high-temperature insulation for higher temperatures. One of its chief benefits in the power plant, next to its contribution to fuel conservation, is its ability to provide insulation protection year after year with no loss, under normal conditions, of its high initial insulating efficiency.

Insulation Thickness

Fittings and valves are insulated with 85% Magnesia blocks and insulating cement to a thickness equivalent to the adjacent pipe insulation. Pipe insulation is stopped at a sufficient distance from the flange or flanged fittings to permit free removal of bolts, and the insulated blocks are wired around the flange to extend not less than 2 in. over the adjacent pipe insulation. Cement finish is applied in two coats to a total thickness of ½ in., the first or rough coat being allowed to dry before application of the smooth finish coat.

Instead of blocks, short sections of pipe insulation may be more conveniently used around a flange of a size which fits snugly. Outdoor pipe lines should always be weatherproofed after the insulation is applied.

Exposed steam and water surfaces of boilers, feedwater heaters, steam pumps and turbines are insulated with blocks. Horizontal return tubular, fire box type and cast-iron sectional boilers and the drums of water tube boilers generally use 85% Magnesia blocks 1-in. thick for steam pressures up to 25 psi; 1½ in. thick for pressures up to 100 psi; 2-in. thick for pressures up to 200 psi, and 2½ in. thick for pressures above 200 psi. Steam turbines at temperatures below 300 F are insulated with 1½ in. thick 85% Magnesia blocks; at temperatures from 300 to 400 F, 2-in. thick 85% Magnesia blocks at temperatures from 400 to 500 F, 3-in. thick 85% Magnesia blocks. Turbines at temperatures between 600 and 700 F are insulated with 1½ in. high temperature insulation and 1½ in. 85% Magnesia blocks. For higher temperatures, recommendations are generally made by the individual supplier according to specific conditions encountered. Feedwater heaters are insulated with 1½ in. 85% Magnesia blocks and on pump cylinders and chests, 2 in. 85% Magnesia blocks are used.

Two coats of insulating cement to a total thickness of ½-in. reinforced with hexagonal mesh wire are applied over the blocks. Where there is danger of damage to the insulation in service, as on a steam pump or turbine, protection is sometimes provided by a suitable metal jacket.

Experience has shown that insulation over boiler brickwork is an additional means of saving fuel and providing closer temperature control. An outer layer of high-temperature or 85% Magnesia insulation, or high-temperature and Magnesia combination insulation is often used of a thickness depending on the design of the boiler. The insulation may be applied behind or between the buckstays.

Boiler water walls usually are insulated with about 4 in. of 85% Magnesia blocks or, in cases of high temperatures, with high-temperature insulation alone or in combination with 85% Magnesia blocks.

No effort is made here to give a complete picture of insulation requirements over the complete range of power equipment, but merely to highlight the versatile contribution which insulation makes to efficient operation.

Detection of Damaged Insulation

Bare surfaces or damaged insulations are easily detected but to detect the inadequately insulated surfaces requires observation and care. Exterior insulation surface temperatures are a good indication. If they do not exceed 55 or 60 F above the temperature of the room, they are generally giving satisfactory performance. Brown or scorched spots on the outer canvas jackets at the joints of sections indicate poor design or poor installation. Such insulations should either be replaced by double layer broken joint construction or the old insulation should be re-applied with tight joints. Loose insulation can be a heat waster. Ability to move insulation slightly, say about 1/16 of an inch, need give no concern but if a greater movement can be obtained, re-application of the insulation is indicated.

Important in all approaches to insulation problems, particularly the "care and feeding" of current insulation, is the teamwork, mentioned above, with insulation specialists. Don't use rule-of-thumb methods in determining insulation needs. Avail yourself of the specialized training and vast store of information of your insulation supplier as your best insurance of "healthy" insulation today and for many years to come.

Editor's Note—Readers are referred to page 96 of the September, 1944, issue of Power Plant Engineering for an article, entitled "Insulation—How to Install It," which deals with the preparation of the surface, details of installation, the application of finish, for mineral wool blankets, blocks, insulating cement and pipe insulation for heated industrial equipment.—*Editor.*

Electric Power Practice in Germany

A brief abstract of a report resulting from an investigation of electric power practice in Germany by Herbert J. Scholz of Commonwealth & Southern Corp., Birmingham, Ala., and C. F. Wagner, Westinghouse Electric Corp., Pittsburgh. This investigation was made shortly after VE Day at the request of the U. S. Government. The authors were empowered with authority to inspect the German Utility systems

SHORTLY AFTER V-E DAY an investigation was carried out in Germany to uncover what might be new in German electric power technique and practice through personal inspection of plants and interviews with informed German engineers. In general, this investigation showed that there had been little or no advances in the art that had not been known regarding German technique as of 1939. This, however, is understandable for, as pointed out by several German engineers interrogated, practically all developments not directly concerned with furthering the war effort had been held in abeyance during the war years.

While new developments were found to be of a minor nature, there are nevertheless some practices that differ from those in other countries and these are worthy of study and review. An underlying influence that effected design and practice was the provision for operating the equipment under war conditions. Perhaps the outstanding differences and developments are 1, the general use of the Petersen coil on 110 and 220 kv circuits; 2, the almost universal use of the air and low-oil instead of the conventional oil circuit breaker; 3, the projection and design of a 400-kv, a-c transmission system with its associated apparatus; 4, the projection and design of a 400-kv, d-c transmission line to be operated on an experimental basis over underground cables for a distance of about 100 miles.

One of the surprising features of the German electrical system was that in view of the complexity and the extent of the German systems the system planners seemed to have made very little use of alternating-current calculating boards in laying out their systems. As evidence, there has been available for all of Germany only one board located in Berlin for this purpose.

Turbo-Generators

Recently built turbo-generators are usually two pole, 3000 rpm machines. Some standardization of 3000 rpm machines between 2500 and 64,000 kva has been undertaken. The normal power factor, according to this standardization is 0.8, but 0.7 will be supplied. Generators with power factors as low as 0.625 were observed in numerous places. Short circuit ratio of not less than 0.7 was usually supplied, but generators with short circuit ratios as low as 0.5 have been built. Hydrogen cooling has not yet been used, however, there is some consideration being given to a trend in that direction.

The prevailing generator voltage ranges from 5500 to 6500. However, some recent machines of 50,000-kw capacity have been built for 10,000 to 12,000 volt operation. Only one higher voltage generator was found or heard of and this generator was built and operated at 21,700 volts. It was supplied for installation in an underground plant for military security reasons and the high voltage was chosen to conserve space required for step-up transformers which would otherwise be required to supply power to a 20 kv cable system.

Direct-connected exciters with pilot machines appeared to be the trend of the industry. No electronic exciters were observed nor had anyone interviewed heard of them.

Transformers

In the 110-220 kv class the trend is toward the construction of self-contained, three-phase transformers having forced oil and forced air cooling. The 100,000 kva three-phase unit has been standardized for all of Germany so that in an emergency it can be shifted readily from one plant to another. To this end, two special railway trucks were constructed and the transformer with walls specially reenforced for the purpose, hangs between the two trucks during transportation.

Smaller transformers are usually self-cooled with externally attached radiators. However, larger sizes usually employ forced circulation of oil through external radiators, cooled either by forced air or by water circulation. No recently built transformers were observed which contained water-cooling coils within the transformer tank itself.

Great emphasis has been placed on having large transformers built to permit transport over mainline railways from station to station or to manufacturers' plants with minimum disassembly of the transformers. In fact, in specifying the 400-kv transformers for use on the projected 400-kv transmission extension, the ability to transport the units complete was to be a primary requirement.

Circuit Breakers

Conventional oil circuit breakers in the 110 and 220 kv classes have been replaced almost universally with air breakers or breakers of low oil content. The stated reason for this action has always been the danger of fire, particularly in time of war. Cost of oil in Germany also offset the greater cost of construction of the air breaker. Four general types of breakers were observed but only three of these have received general acceptance. These are: a, The Siemens-Schuckert; b, The A.E.G. Freistrahl breaker which uses air at high pressures both for rotation of the insulator stacks and for interruption of the arc; and c, The Brown Boveri high-voltage circuit breaker which also utilizes air at a pressure of 200 psi, to operate the breaker and to interrupt the arc. Only two breakers of this type have been installed in Germany, one, a 110-kv breaker at Brauweiler Substation and one, 220-kv breaker at the Marke Substation. Both have a rated interrupting capacity of 2500 mba.

None of the high-voltage circuit breakers of any manufacture have, so far as is known, been given full laboratory tests at their ratings nor have staged field tests, such as made in the United States, been carried out. In addition, no automatic oscillographs are installed to give an accurate record of actual short circuit current.

Short Circuit Protection

Conventional differential relay protection is provided separately for generators and transformers even when switched as a unit. In cases where built - in, tap - changing - under - load equipment or separate regulators are included in the transformer differential scheme, auxiliary relays are added to prevent faulty operation on true faults. To guard against faulty operation from inrush current, a timing relay is included to introduce a specific time into the tripping circuit. No installations of bus protection were found.

High-voltage lines are protected quite generally by impedance type relays for both phase-to-phase and phase-to-ground faults. Such protection on short lines is supplemented by blocking signals transmitted over cables between the stations interconnected. No "carrier" relay installations were encountered but the impression was gained that a trial installation had been considered but deferred on account of the war.

As is well known, universal use is made of Petersen coils on all circuits from about 30 kv to and including 220-kv. These are distributed over the network to permit proper tuning for all combinations of line length and

Petersen coil reactance. To take care of possible asynchronous operation of circuits, on double circuit towers an auxiliary reactance coil called "Saug Spule" is connected in series with the conventional Petersen coil. All Petersen coils have ample capacity to permit operation of the system with ground fault for a period of time sufficient to permit manual switching and location of fault.

Electric Drives for Power Plant Auxiliaries

The universal voltage used for electric motor drives for steam power plant auxiliaries consuming 100-kw or more is 6000 volts. Smaller motors are wound for 380 volts. Most variable speed motors driving forced and induced draft fans are of the brush-shifting type. The brush-shifting rigging is motor-operated and tied in with the combustion control. Motors are either totally enclosed or of the box-frame construction. Where totally enclosed motors were used, the air was circulated through water or forced air coolers instead of installing an over-sized motor. In this manner the motor windings operated in low ambient air thus reducing the size of the motor. Whether this is economical in America would depend on total cost of material and labor under both methods, but warrants an analysis to determine the relative merits of the two schemes.

It is interesting to note that in the underground station in Mannheim where the highest voltage generator (21,700 volts) was installed, the voltage for motors driving plant auxiliaries was lower (1000 volts) than customarily used in other plants throughout Germany.

Station Design Electrical and Physical Arrangements

In the case of generating stations where power is supplied direct to high-voltage transmission systems through step-up transformers no generator circuit breakers are installed. The generator and transformer are switched as a unit on the high voltage side. Power for station auxiliaries during starting up periods is secured through separate step-down transformers from the system.

Low voltage busses are bare copper, aluminum or magnesium bars and are preferred in the order given. Shortage of copper and aluminum during the war necessitated use of magnesium. Rarely are barriers provided between phases although they are provided between circuits. Indoor disconnections are generally gang operated and often pneumatically opened and closed. Outdoor disconnecting switches are usually motor or pneumatically operated.

Transformers and high-voltage breakers are generally installed outdoors. However, in some chemical plants high-voltage transformers and even 110-kv breakers were observed installed indoors because of fumes and dirt. High voltage switchyards are generally laid out horizontally because of cheap and available land and to conserve steel.

System Stability

Most of the system engineering for the RWE system, one of the two most extensive transmission networks in Germany, comes within the responsibility of Dr. Roser. He is, therefore, in position to know the operating characteristics of this system that extends from Switzerland and Austria to the Ruhr Valley. It was comprised in 1939 of 1960 miles of 110 kv and 1440 km of 220-kv lines. Dr. Roser is authority for the statement that they do not have a stability problem. When the system was first started they had had severe trouble but as the load increased and additional generating units have been added, the system has become more and more stable. This follows because the load and units were added near each other.

From the flow diagram and from Dr. Roser's statements, it is clear that the 220-kv lines act very much as a backbone bus. At light loads the 220-kv line is used in part to transfer the excess of the hydrogenerated power to Koepchenwerk and other pumping stations.

It is interesting that not until recently has there been an alternating current calculating board in Germany. A single one had been built by Siemens-Schuckert in Berlin. From what can be learned the RWE system had never been set up on this board. This is further evidence that they had no stability problem.

System Operation

Load dispatchers are generally equipped with good communication either over metallic overhead or buried cable, or power line carrier. Remote indication of voltage levels and line loading at strategic locations on the system are telemetered to dispatching points either through cables or by power line carrier. Dispatching centers at Berlin and Zschornervitz in East Central Germany could not be visited. The dispatching center for RWE (largest system in West Germany) is located at Brauweiler Substation. This office is well equipped with communication and telemetered information. After each switching change, the dispatchers board with system connections represented thereon is photographed during normal peacetime conditions by a Leica camera mounted in a fixed position. Thus, actual system conditions can be recorded in minimum space and projected on screen or printed in enlarged form for subsequent analysis.

Frequency for West Germany was controlled by RWE at Herdecke pumped-storage hydro plant or other assigned plant. Frequency in the East Central part of Germany was normally controlled at Klingenberg steam station in Berlin and infrequently at Zschornewitz. Such control on the extensive RWE system, was accomplished manually as automatic frequency controllers had not as yet been employed. Neither had automatic tie line load control been applied on the RWE system necessitating schedules to be maintained either by isolating generation or by manual means.

On the Bayernwerk system, however, it was observed that equipment for automatic frequency and tie-line load control had been in use for many years. Controllers were located in the central dispatcher's office and impulses sent by power line carrier to either of two hydro plants, whichever was assigned the task of regulation. This scheme was described in a paper presented at the World Power Conference in Paris in 1935. When the Bayernwerk system operated interconnected with either RWE or EWAG, frequency was not regulated by Bayernwerk but tie-line load was automatically controlled.

From Berlin engineers, it was learned that automatic frequency controllers were installed in the dispatcher's office of BEWAG located at Klingenberg Power Station where four 50000 KW steam units were given impulses to regulate frequency. Because of manual tie-line control employed by RWE difficulty was experienced in operating Eastern and Western Germany in parallel across the Prussian system lying between these two large systems. Often violent load fluctuations occurred in the tie lines causing the systems to separate from overload. It was therefore normal practice to split the Prussian system at a proper point and operate part of it in synchronism with the East and part of it with RWE in the West.

400-kv Transmission

As the brown coal reserves, which are located in the northern part of Germany became depleted, it had been planned to develop the southern waterpower resources. In this case a real long distance power transmission problem would be superposed upon their present problems. To meet this situation they were planning the conversion of the 220-kv lines to 400 kv and had designed many of the lines with this in mind.

Experimental work had been done in a region of heavy ice and sleet on a five kilometer length of conductor and on a 200-kilometer length that would be suitable for operation at 400 kv. This conductor consisted of four individual cables located at the corners of a square measuring 15.7 inches on a side. The primary purpose of this configuration is to prevent corona. Each cable had a cross-section of 237,000 cm making a total of 948,000 cm per conductor. The configuration of the cables was maintained by spacers located 50 to 80 meters apart. The individual conductors were sagged in position and a workman on a dolly was pulled along the conductor to clamp the cables in position. The clamp consisted of a circular ring with appropriate clamps located around the periphery.

While some of the towers operating at 220 kv were intended for future op-

(Continued on page 134)

What the Power Engineer Needs to Know About

THE BELT CONVEYOR

Capacities of belt conveyors . . . Factors contributing to belt destruction . . . Belt speeds and stresses in belts . . . Trippers and magnetic pulleys . . . How maintain belt conveyors . . . Lubrication . . . Maintenance costs

By Wilbur G. Hudson **Consulting Engineer**

THE BELT CONVEYOR has an endless belt made up of rubber-embedded cotton duck in several plies, depending on the pull to which the belt is to be subjected, and protected on the carrying and under sides by a suitable thickness of rubber covers. Along the carrying run, the belt rests on three-pulley troughing idlers, and the return run on straight-face idlers. If the belt is to run straight it must rest on the central roll of the troughing idlers, so a width of at least 14 in. is advisable even with a belt of minimum thickness and flexibility.

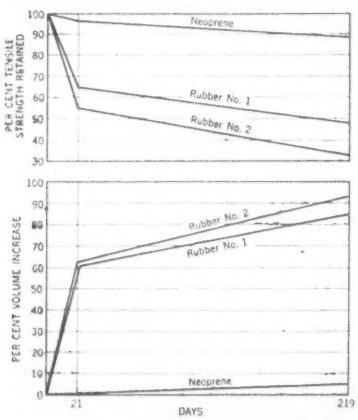


Fig. 1. Effect of immersion in S.A.E. lubricating oil at 82 F on tensile strength and volume of rubber and Neoprene. (du Pont)

Rubber swelled rapidly for the first 21 days, with sharp drop in strength. Swelling and strength loss continue for the remainder of the test period of 219 days. Neoprene shows a slight swelling and strength loss of 11 per cent compared with 52 per cent and 68 per cent for the two rubber samples

As between a belt conveyor and a bucket elevator, the former with its supporting bridge structure will usually cost more. Maintenance costs with coal are about the same, though the belt conveyor has more risk of costly accident than the elevator. For the large capacities, as required for the great steam plants the inclined belt is preferred. The inclination should be conservative — not more than 18 deg or 20 deg. Capacity and other data are given in Table I.

Factors That Shorten Belt Life

Replacement of a belt is costly and every care should be taken to secure maximum life. Factors contributing to its destruction are:—

1. Oil-sprayed coal. This causes the rubber to swell and rot, and the plies to separate so that in a few weeks the belt is ruined. Some of the synthetics resist this action; in fact, conveyor belt manufacture is in a state of flux at present. It is quite possible that synthetic rubber will eventually be better than natural rubber, and that a Nylon carcass will be better than cotton duck. Figure 1 shows the results of tests by the du Pont Co. on rubber and Neoprene subjected to the action of lubricating oil.

2. Impact at the loading point. Lumps striking a belt resting on an unyielding idler cause a multitude of cuts and bruises. Various shock-easing idlers are available. For power plant service, cushion-tired discs or idlers shod with soft rubber are suitable.

3. Overtaxing the strength of the carcass. Each belt has a rated maximum allowable tension, usually about 35 to 40 lb per inch width per ply, and it is important that this be not exceeded.

4. Stray fragments cutting the belt. It is dangerous to use a plank hopper lined with sheet steel nailed to its sides. The writer has seen a belt sliced silently and quickly into two belts by a section of lining that had slipped down and lodged in the loading chute.

A belt should be operated at the slowest speed at which it can carry the load. If the capacity may later be increased because of additional

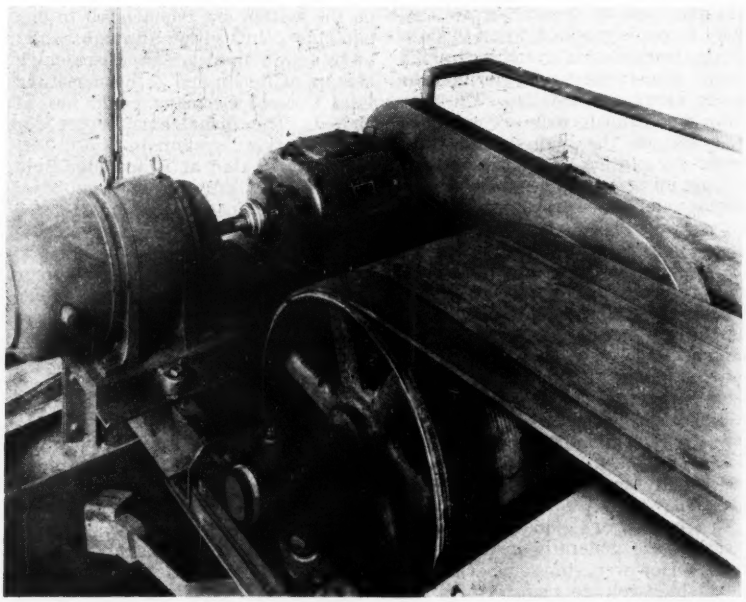


Fig. 2. Well designed drive at head end of 30-in. belt conveyor. Adjustable anti-friction head shaft bearings. Enclosed roller chain drive to herring-bone gear speed reducer. Flexible coupling between reducer and motor, which are mounted on a single rigid welded steel base

boilers, it is better to specify a belt suited to a larger capacity with the speed reduced to suit the initial requirement.

Where coal is received from a track hopper this should be designed to empty quickly. It has long been standard practice to have the hopper sides at 45 deg, which makes the valley angles 35 deg. While these cleared fairly well with mine run coal, the growing use of small coal calls for steeper hoppers. With the sides at 50 deg the valley angles are 40 deg. With the sides at 60 deg and 50 deg the valley angles are nearly 45 deg. Even then small coal sometimes does not clear readily. Straight discharge chutes at 45 deg still are steep enough for small coal, and if it does at times stick when damp, a floor liner of stainless steel eliminates the difficulty.

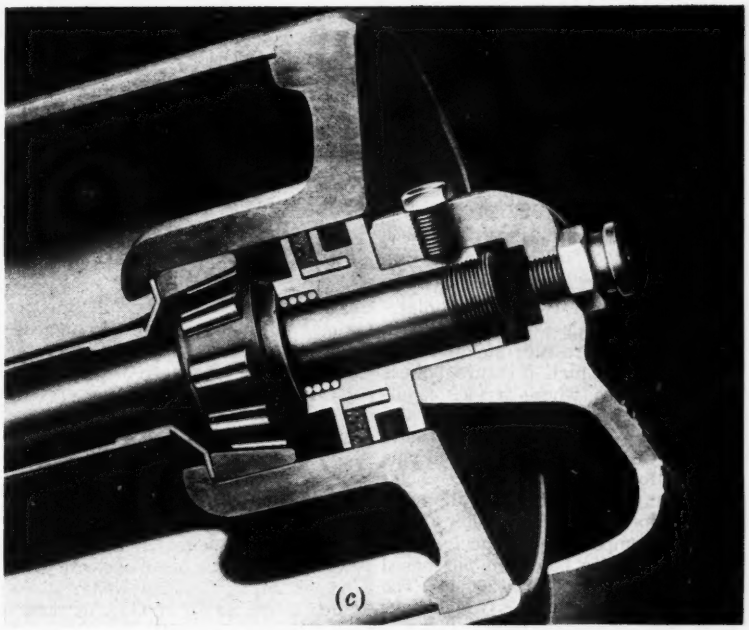


Fig. 3. Section of troughing roll (Robins). Self-adjusting Timken anti-friction bearings. Lubricant injected to chamber behind bearing unit. Labyrinth grease seal. Shell spun over heads. Troughing rolls usually are 6-in. diameter for middle range installations

General Outline of Conveyor Design

The engineering of belt conveyors is too complex a subject to be covered here except in outline. The reader is referred to *Belt Conveyors and Belt Elevators* by Hetzel and Allbright and *Conveyors and Related Equipment,* by Wilbur G. Hudson, both published by John Wiley & Sons, Inc.

In selecting a belt conveyor the first step is to ascertain the width of belt and the speed which will provide the desired capacity, then check to see whether the width is suitable for the maximum lumps expected. The power required is the total of that required to run the empty belt, that required to move the load horizontally, and that required to lift the load. The manufacturers furnish, on request, tables or curves giving this information. Having determined the power, it is necessary to check for the maximum pull to which the belt then will be subjected. This pull, the width, and the number of plies, give the stress per inch width per ply, which varies with the different manufacturers, as shown in Table II.

The B. F. Goodrich Co. manufactures a "Cord" belt, constructed somewhat like a cord tire, in which plies of longitudinal cords embedded in the rubber form the carcass and take the tension. This belt should have very good resistance to impact shocks because of the greater percentage of rubber, as well as flexibility transversely.

In power plant work, where the belt conveyor usually is inclined as steeply as permissible, it will be found that the power to lift the load often exceeds the power required to move the belt empty plus that required to move the load horizontally. Then it is essential that an automatic brake be provided at the head end so that the conveyor will not reverse when the power is off while the belt is loaded.

Feeders and Trippers

The belt conveyor requires a feeder, and this should be interlocked either mechanically or electrically with the conveyor, preferably so that the feeder cannot be started until the belt is up to speed, and, of course, so that when the conveyor stops the feeder will stop.

Distribution to the bunker usually is by a tripper which snubs the belt over two idler pulleys to permit the load to pass off. In a small installation, the tripper carriage may be propelled by hand, but it is more convenient to have it self-propelled by power taken from the belt by chain drive to the carriage axle. Then the tripper travel is determined by reversal stops alongside the run, and requires little attention.

Where it is essential to remove stray fragments of iron from the coal, the conveyor run may be separated into two units with a magnetic head pulley on the first, or an apron feeder with magnetic head pulley may be used. The electromagnetic unit is mounted between the head sprockets; the apron becomes magnetized approaching the head so that fragments adhere for several feet along the return run before dropping off. The skirt-boards should be non-magnetic. Also, if stray debris, such as rags, hay, wood, etc., as well as tramp iron, must be separated, the hammermill is available.

Belt Conveyor Maintenance

The belt conveyor asks for more careful operation than other types of

(Continued on page 134)

Table I. Capacities and speeds for various belt widths

Belt width inches	TPH with coal at 100-ft per min	Max. speed ft per min	Spacing: Carrying idlers*	Max. lump inches
14	17	250	5′-6″	3
16	22	300	5′-6″	4
18	28	300	5′-6″	5
20	34	350-400	5′-6″	6
24	50	350-400	5′-0″	8
30	79	400-450	4′-6″	10
36	114	400-450	4′-6″	12

*Return idlers all 10′-0″

Table II. Maximum belt stresses in pounds per inch per ply

Weight of Duck Ounces	Link Belt	Goodyear	U. S. Rubber
28	25	24	24
32	30	27	27
36	35	30	30
42	45	45	40

Manufacture of Large Heavy Wall Pipe*

By E. C. WRIGHT

Assistant to President,

National Tube Co.

High pressure steam mains require piping suitable for 800 to 2000 psi pressure and 1000 F temperature . . . Table of typical sizes is given . . . Manufacture of large sizes is limited to few mills . . . Small orders are expensive to produce . . . Severe inspection of product required . . . ASTM specifications have been subject to frequent change . . . Mill stock piles would work to advantage of heavy wall pipe users

MOST HEAVY-WALL large diameter, seamless pipe has been used for high pressure steam mains connecting the high pressure boilers to the turbines, where service conditions range from 800 to 2000 psi and temperatures range up to around 1000 F. Occasional uses for such pipe are also found in high pressure chemical plant and oil refinery equipment, and for special hydraulic piping used at room temperature. Pipe for high temperature use has been purchased to ASTM Specification A-206-447. The table shows typical sizes which have been most commonly used.

Very few steel mills in the United States can roll rounds over 7 in. in diameter, such as are required by seamless tubes. As a result, the purchase of rounds in small quantities for small orders of pipe becomes troublesome. Unless a whole heat of steel is purchased, large rounds can usually be obtained only in forged sizes. Since these are quite rough and inaccurate in diameter, the tube manufacturer must turn or peel such rounds to remove surface defects and get accurate dimensions for piercing.

The steel melter is also troubled with the problem of selecting the proper ingot size and weight to cut such billets as 12 in. O.D. by 5000 lb or 10½ in. by 3500 lb. Often the available ingot mold size and weight of ingot is such that only 50 to 60 per cent of the ingot can be cut to the proper weight billet. This is particularly true in the case of alloy steel melting shops with electric furnaces where ingot weights rarely exceed 15,000 lb and where 8,000 to 10,000 lb ingots are usually standard equipment. Thus, it is possible to cut only one round billet weighing between 4,000 and 6,000 lb from an ingot weighing 10,000 lb since the normal crop loss from hot topping and bottom cropping frequently exceeds 25 per cent.

Dimensions of commonly used high temperature pipe

O.D., In.	Wall Thickness, In.	Schedule No.	Weight per Lineal Ft, Lb	Nominal Length to Cut, Ft	Rolled Length Before Cutting, Ft	Weight of Rolled Pipe, Lb
10¾	1.125	160	116	25	31	3596
10¾	.843	120	89	30	36	3204
12¾	1.312	160	160	25	31	4960
12¾	1.000	120	125	30	36	4500
14	1.406	160	189	35	31	5860
14	1.062	120	147	30	36	5192
16	1.562	160	241	20	26	6266
16	1.218	120	192	25	31	5952

Fig. 1. Piercing billet for making large size seamless pipe

With an order for very large sizes, such as 16 in. O.D. by 1 9/16 in. wall (Schedule 160), the ordinary mill setup used for rolling 16 in. O.D. pipe of nominal wall thickness is not satisfactory and it is necessary to adjust the first and second piercers, use a different Hi-mill bar and plug, change the reeling machine, and sometimes change the sizing rolls. In addition, the billet weight for such a pipe size is so heavy, often being over 6,000 lb that the heating furnace will not accommodate the desired round because of excessive length. This requires the use of a billet of greater diameter than normally required to keep the length within the heating furnace limit. Therefore, the piercing mill passes used for ordinary 16 in. O.D. pipe cannot be employed.

As a result of these conditions, extensive changes and rearrangement of equipment always becomes necessary when special heavy wall pipe is to be made, either when the pipe mill has previously been rolling a similar diameter with a light wall, or a smaller diameter. It takes from three

*Condensation of paper presented in Bulletin of American Society for Testing Materials.

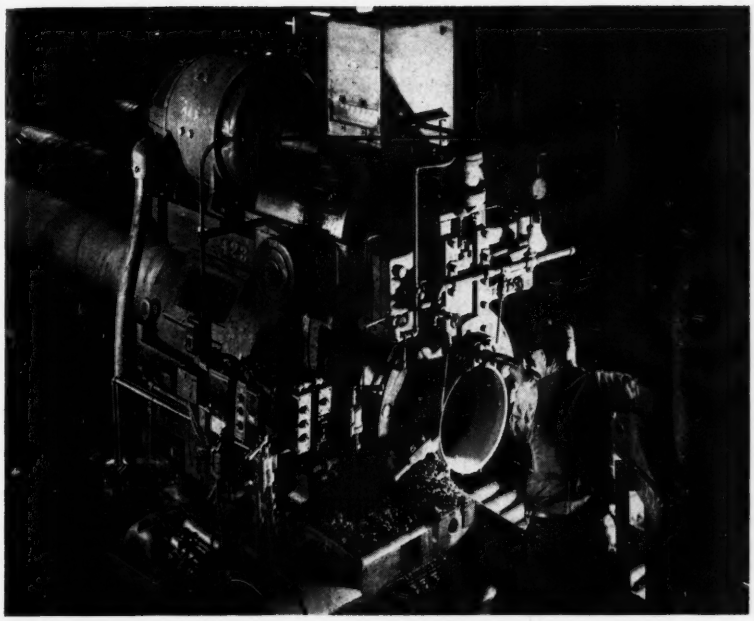


Fig. 2. Cutting off ends of 20 in. O.D. seamless pipe

to five hours to change the mill set-up, and the cost of this non-productive delay is high. During these mill changes, furnaces are kept in operation and the full mill crew is engaged in the rearrangement. And after the special rolling a similar set of changes is required to resume production of normal pipe.

Orders for large diameter and heavy wall pipe rarely exceed 1000 ft and this represents only forty pieces 25 ft long. Such a quantity can ordinarily be rolled in one to two hours. The total mill time employed in producing 1000 ft of a special size would approximate ten hours, so the operating cost and overhead charges per ton for producing such quantities in these sizes are often from five to ten times those for producing a given quantity of ordinary pipe and tubing sizes. Further, the rolling of special sizes on the mills is extremely difficult and frequently a number of pieces are cobbled or lost due to difficulties in handling the heavy billets and to the lack of experience of the crews in setting the mills and operating them to the best advantage. As a result, large rollings of special analysis and special large diameter heavy wall pipe are never made, since they are not standard purchases and overages of these odd pipe sizes cannot be sold within a reasonable time and frequently must be scrapped. Consequently, pipe manufacturers have generally insisted that rollings of this nature be limited to minimum quantities of 1500 ft.

Due to the fact that special heavy wall alloy steel tubes are used for very high pressures and severe temperature conditions, the inspection of the finished material is the most severe that is encountered in the pipe industry. It is necessary to pickle or descale the surface of the metal to develop the defects, and then a considerable amount of grinding is required for the removal of pits, scratches and light seams. Frequently a long length must be cut in the center to remove a defect and this will leave two short lengths, sometimes less than 10 ft of good material. It is mainly because of the severe inspection that the mills insist upon shipping short lengths down to 6 ft.

ASTM Specification A-206 has been changed every year since it was originally written in 1937. This situation has made it impossible for manufacturers to stock special heavy wall large diameter pipe sizes, and at the present time the profound changes in chemical analysis and steel melting practice which are being considered for this specification make it utterly impossible to consider any stock for at least the next two years.

As a result of the complexities involved in the manufacture of this kind of pipe it has become evident to National Tube Co. that the only way in which such special pipe can be manufactured on any basis approaching a commercial production operation is to standardize on the following features:

1. Roll only certain wall thicknesses, such as Schedule 120 and Schedule 160, for any given diameter.
2. Roll only one length in any given diameter and wall thickness.
3. Purchase billets of only one diameter and weight for rolling each size of pipe. This will enable the mill to produce one standard length of pipe in each size.

It is suggested that a table such as that shown here be incorporated in ASTM specifications instead of the present American Standard B36.10-1939 as the manufacture of all the 20 sizes of pipe between 10¾ in. O.D. and 16 in. O.D. and Schedules 80 to 160 would make it impossible for mills ever to accumulate commercial stocks in all these sizes. Under the proposed suggestion, however, it will be possible for mills gradually to accumulate a stock of round billets suitable for rolling a given pipe size, the length varying according to the mill's facilities.

Rollings of the pipe must be limited to minimum quantities of 1500 ft, which will make it necessary for consumers to purchase such a quantity or have their orders for lesser

(Continued on page 98)

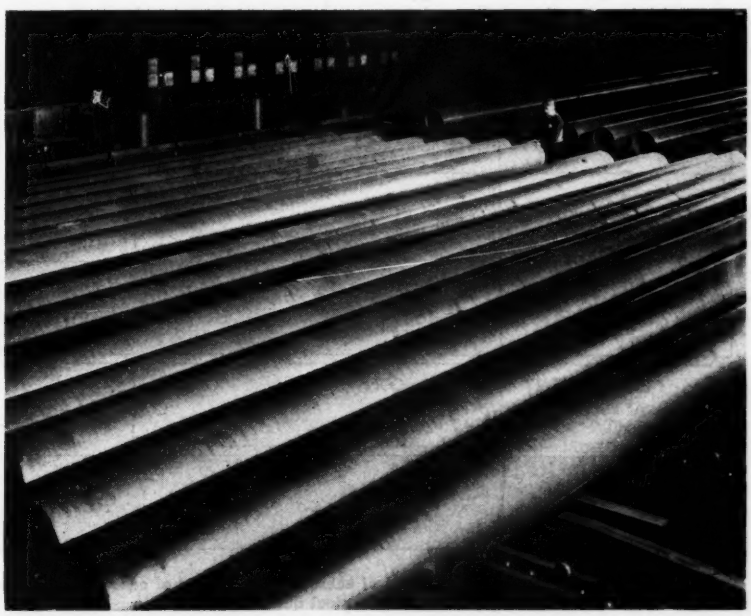


Fig. 3. Inspecting large size seamless pipe

Fluorescent Lamps and Lighting

This is the first of two articles dealing with the practical aspects of fluorescent lamps and lighting. This article discusses briefly the characteristics of fluorescent lamps, how these characteristics compare with those of other types of electric lamps and the various types of fluorescent lamps available. A second article to be published next month will deal with the circuits and different types of ballasts used with commercial types of fluorescent lamps together with a brief consideration of the various installation and maintenance factors.

By A. K. Gaetjens

Lamp Department, General Electric Co. Nela Park, Cleveland, Ohio

ELECTRIC POWER is the most versatile servant of modern life. Generated principally in vast central station plants, its usefulness is greatly enhanced because it can be subdivided into any size of unit desired. For example, lighting is the greatest single revenue producer of the industry and yet the average size of lamp which converts power into light is only a small fraction of a kilowatt.

The power plant engineer is naturally interested in lighting for a number of reasons. Historically, the use of power for lighting brought about the creation of the central station. Thus, the lighting industry was its first customer. This is commemorated in the large number of utilities whose titles still contain the words "Light" or "Lighting." Also every domestic user of power still regards his monthly statement as the "light bill" regardless of the number of appliances he may be using. Second, as mentioned above, lighting returns more revenue to the industry than any other use of power. Third, and it is from this viewpoint that this article is being written, the engineer is a user of light—in his home, his business, his car, his recreation, on the street, if he is ill—in a thousand and one ways electric lighting touches every facet of our world today.

For many years the lighting industry enjoyed a steady growth but was essentially stabilized as to light sources by the almost universal acceptance of gas filled Type C (tungsten filament) lamps for nearly every purpose. The other light sources in general use were mercury (Cooper-Hewitt) lamps for some industrial applications and neon tubing for outdoor signs.

Type F (fluorescent) lamps became commercially available in 1938. They made possible the efficient production of colored light for the first time and were applied primarily for decorative purposes. In this manner they were first widely used at the New York and San Francisco Fairs. However, the installation cost was high, the variety of lamps available was extremely limited and there were few prophets bold enough to forecast that within a few years fluorescent lighting would be considered for nearly every new lighting installation and be used in a large percentage of them. Such a rapid acceptance of a new and completely different light source has brought about a veritable revolution in lighting practice, and considerable confusion exists as to the proper application of these lamps. A comparison of the principal differences between F lamps and the more familiar C lamps may clarify some of these points.

1. C lamps in the most generally used sizes are approximately 40 per cent as efficient a light source as the most widely used F lamp, the 40 watt white.

2. For a given illumination C lamps therefore introduce two and one-half times as much heat into the interior being lighted. Where the area is air conditioned, this results in a considerably increased air conditioning load. Also, approximately 90 per cent of the wattage of a C lamp is dissipated as visible light or radiant heat. While the lighting installation rarely has an appreciable effect upon the ambient temperature of the room, occupants frequently notice, or believe they notice, the radiant heat directly from the lamps. In an F lamp, somewhat less than 50 per cent of the energy appears as light or radiant heat and the rest of the energy is dissipated through convection and conduction (Fig. 1). This fact, plus the increased efficiency of F lamps, results in their having approximately 20 per cent as much radiant heat per footcandle as C lamps.

3. The colors in which F lamps are most commonly available — daylight and white, are psychologically cool in

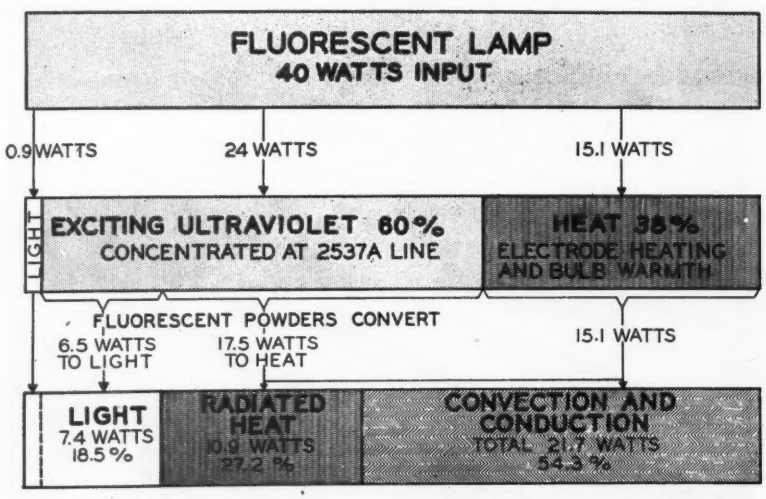


Fig. 1. This diagram shows the distribution of energy and the steps of energy conversion from power to light of a typical fluorescent lamp

comparison with the somewhat yellowish white light of C lamps. This factor, plus the reduced radiant heat per foot candle, creates an impression of cooler light and greater physical comfort in a room lighted with F lamps.

4. Probably of greatest importance is the difference in the physical nature of the two lamps. Lighting practice for many years has tended away from small, bright light sources to larger, more diffused sources which provide improved seeing conditions. The lighting quality of an installation for general purposes is frequently judged in terms of the degree of shadow and the amount of directed and reflected glare. Fundamentally, F lamps are large, relatively low brightness sources; thus a higher quality of illumination can be achieved more simply and efficiently with them. On the other hand, C lamps fundementally are small, extremely bright light sources, and methods of producing a good quality of lighting with such sources are inherently less efficient and practical. Through the years when C lamps were the chief illuminant available, methods of providing a good quality of lighting had been evolved, such as indirect lighting for offices and the Glassteel Diffuser for industry. The disadvantages cited above were accepted as a necessary evil.

There has been a constant trend for many years toward lighting installations of better quality and more illumination. The F lamp made such installations more practical than they had been heretofore. Thus, the F lamp immediately achieved a wide acceptance despite its more complicated circuit and higher first cost.

On the other hand, there are many applications for which the characteristics of C lamps prove more satisfactory than those of other illuminants. The lower first cost of C lamp installations is a major consideration for storage and similar areas where the lighting is used but little and the quality of lighting is of minor importance. The concentrated filament permits a high degree of control of light, practically essential for such services as narrow high bay industrial, street lighting, projection, stage, spot and floodlighting.

Varieties of Fluorescent Lamps

In the relatively few years since their introduction, the variety of F lamps in terms of the basic construction, size and wattage has multiplied rapidly. There are three general classifications of F lamps: tungsten (hot) cathode lamps, iron (cold) cathode lamps, and the rectified fluorescent (RF) lamps. Of the three, the tungsten cathode type is by far the most widely used, and after the following brief description of the differences in the three general types discussion will be confined to this source.

The tungsten cathode F lamp is an electric discharge light source consisting of a tubular bulb with an electrode sealed in each end (Fig. 2). Each electrode incorporates a tungsten filament cathode which is coated with an active electron emissive material and two antenna-like anodes. There is no metal wiring inside the lamp connecting the two ends, and electrons flow by gaseous conduction from the cathode at one end to the anode at the other when proper voltage is applied. Thus, on normal alternating current operation, current flows first in one direction, then the other, through the mercury vapor contained in the tube. (Fluorescent lamps, because of their necessary auxiliary control equipment described later, are the best employed on an alternating current supply although they will operate on direct current with certain precautions and restrictions, notably a considerably reduced overall efficiency).

Figure 1 is an analysis of the two steps of energy conversion which are occurring constantly in an F lamp. It will be noted that only a small amount of visible light is produced in the electric arc or discharge itself. More than one-half the total energy is in a single line of the ultra-violet spectrum. As this energy impinges on the fluorescent chemicals or phosphors coated on the inside of the glass bulbs, it is converted to visible light and heat. The color of light which is obtained depends upon the particular phosphors selected. The glass absorbs ultra-violet energy shorter than 3000 angstroms so none is radiated from the lamp. There is some ultra-violet energy in the wavelength band from 3000 to 4000 angstroms in the spectrum of an F lamp just as there is from most other illuminants. The physics of energy conversion and light production in such lamps is extremely complex but the above simple explanation is an adequate condensation of the various processes involved.

There are several methods of starting tungsten cathode lamps. The most common is to use a separate starter for preheating the cathodes, any of a number of which operate quite satisfactorily. In order to be assured of a quality product, it is well to obtain one which has been approved by the Electrical testing Laboratories of New York. Certain performance standards have been established and starters which comply with these requirements are issued a certification to this effect.

Tungsten cathode F lamps can also be started without preheating the cathodes by the application of higher voltage. The required voltage is approximately four times the normal operating voltage of the lamp. In comparison, lamps operated on circuits with starters which preheat the cathodes, require only about twice the normal operating voltage for starting.

The name "hot" cathode was originally applied to this type of construction because the arc impinges on a small portion of the tungsten cathode which keeps this segment at a red heat. This is the most efficient cathode design which has been evolved.

Iron cathode lamps differ somewhat in their electrode or cathode construction from the tungsten cathode lamps. Instead of a small tungsten filament upon which the arc impinges, they have a comparatively large iron cylinder coated, in most cases, with an electron emissive material. The entire large cylinder of the iron cathode lamp operates at a temperature of 150° C., which is less than that of the much smaller hot spot of the tungsten cathode lamp. However, the wattage loss and the heating effect of the "cold" cathodes upon the immediate surroundings of the cathodes for typical lamps is twice as great as the heating effect of the tungsten cathodes of the 40 watt F lamps. For equal current through the two types

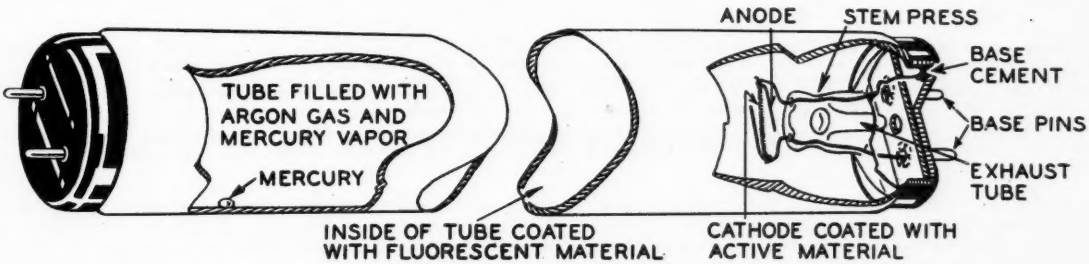


Fig. 2. Sketch of the design features of a standard tungsten cathode fluorescent lamp

TABLE 1—COMMONLY AVAILABLE TUNGSTEN CATHODE T LAMPS

Lamp Watts	Nominal Length	Diameter in Inches	Bulb	Approx. Lamp Amperes	Approx. Lamp Volts	Circuit Voltages	List Price
6	9"	5/8	T-5	0.15	45	110-125	$0.70
8	12	5/8	T-5	0.18	54	110-125	0.80
13	21	5/8	T-5	0.16	95	110-125	0.90
14	15	1½	T-12	0.37	41	110-125	0.70
15	18	1	T-8	0.30	56	110-125	0.57
15	18	1½	T-12	0.33	48	110-125	0.70
20	24	1½	T-12	0.35	62	110-125	0.70
30	36	1	T-8	0.34	103	110-125	0.70
40	48	1½	T-12	0.41	108	199-216 220-250	0.95
100	60	2⅛	T-17	1.45	72		2.15
15 *	42	¾	T-6	0.10	170	110-125	1.55
25				0.20	145		
23 *	64	¾	T-6	0.10	270	110-125	1.75
38				0.20	230		
22 *	72	1	T-8	0.10	245	110-125	2.00
38				0.20	215		
30 *	96	1	T-8	0.10	335	110 125	2.70
52				0.20	290		
32**		1¼	T-10	0.42-3	84-6	110 125	—

* These lamps have been announced and are designed for instant starting circuits. Their commercial availability will depend upon the release for civilian production of the manufacturing facilities for lamps and ballasts.

** This lamp is circular with approximately a 12" outside diameter. It is the first of a line of three such lamps for which a preliminary announcement has been made. They will be adapted to certain specialized industrial applications and are expected to find wide usage in domestic portable lamps.

These lamps are all available in daylight (6500°K) and white (3500°K). The popular 40 and 100 watt sizes are available in a new white, rated at 4500°K. The majority of lamps also are available in the following colors: Blue, green, pink, gold and red.

of lamps the cathode losses are 6-7 times greater in iron cathode lamps. For these reasons the term "hot" for the tungsten cathodes is somewhat of a misnomer.

Iron cathode lamps do not use a preheating starter in the circuit but invariably rely upon high voltage for starting. They are most commonly used in high voltage series circuits with 5000, 10,000 or 15,000-v transformers supplying a string of lamps or tubes connected in series. However, they can also be obtained for multiple operation with smaller ballasts designed to operate two lamps in parallel.

The chief differences between the two lamps described above are:

a. The tungsten cathode lamp is somewhat more efficient than the iron cathode lamp because of the reduced loss at the electrodes.

b. This difference in efficiency in the lamps is increased by the greater ballast losses inherent in the high voltage starting circuits commonly used with iron cathode lamps.

c. The iron cathode lamp is a longer life lamp than the tungsten cathode lamp.

d. The life of iron cathode lamps is not affected practically by the number of starts. They are therefore well adapted to flashing or frequent starting service. The life of tungsten cathode lamps is definitely decreased by frequent starts. Thus, they are better suited to general service lighting.

e. Nearly all lamps decrease in light output as they are operated. This factor of lamp maintenance is usually rated in terms of the per cent of initial light remaining at 70 per cent of the rated lamp life. For equal current through the lamps it is poorer for iron cathode lamps primarily because of their very long life. However, in practice, iron cathode lamps usually operate at lower current than tungsten cathode lamps, a factor which improves this characteristic, and for this reason the lumen maintenance may or may not be different.

f. The cost of comparable installations of tungsten and iron cathode lamps favor the tungsten cathode both initially and in operation.

The rectified fluorescent (RF) lamp was available for new installations before the war and can be obtained for relamping purposes at the present time. It was eliminated for new installations during the period of material shortages as a conservation measure, since the control equipment for it requires approximately twice as much copper and iron in the ballast as is needed for Type F lamps providing an equal quantity of light. This lamp has two anodes at one end and one cathode at the other.

The chief advantage of the RF lamp is a reduction of the stroboscopic effect or cyclic flicker (variation in light output through the alternating current cycle) of a single tube as compared to the other general classifications of fluorescent lamps. To obtain a similar reduction with the other lamps it is necessary to operate two lamps from a Tulamp ballast as described below. The RF lamp was popular for industrial use before the war because it did not require a starter and was equipped with a heavy duty industrial reflector and ballast which were quite suitable for general factory use. Whether it will be available again for new equipment is not known at the present time.

A discussion of lamps and circuits will appear in another article. This will be confined to tungsten cathode lamps because:

1. These lamps have reached a high degree of standardization and are available from several manufacturers in a wide range of sizes.

2. The circuit control equipment also has been highly standardized for these lamps.

Manufacture of Large Heavy Wall Pipe

(Continued from page 95)

amounts accumulate at the producer's plant until a sufficient number of orders to total 1500 ft are entered before the rolling is initiated. Any excess from these rollings can then be placed in stock in the standard lengths, much like ordinary pipe is stocked. When such stocks are accumulated in the standard diameters and wall thicknesses, orders for small quantities may be entertained by cutting small amounts from such stocks. This situation, however, cannot be attained until a definite and standard specification is written and adhered to without annual changes.

ATOMICS

A New Section added to POWER PLANT ENGINEERING to cover current and forthcoming developments in atomic energy and related developments and applications in Nuclear Physics

THE DEVELOPMENT OF ATOMIC ENERGY

This is the third of a series of articles giving a general account of the development of methods of using atomic energy for military purposes under the auspices of the United States Government. This article describes the various problems involved in the design and construction of the large plutonium production plant at the Hanford Engineer Works at Pasco, Washington. All material in these articles is based upon the official Smyth report to the Army

By Andrew W. Kramer ***Managing Editor, Power Plant Engineering***

AS DESCRIBED in the article in the November issue, by the first of January, 1943, the Metallurgical Laboratory had achieved its first objective, a chain reacting pile, and was well on the way to the second, a process for extracting the plutonium produced in such a pile. It was clearly time to formulate more definite plants for a production plant. The only decisions that had already been made were that the first chain reacting pile should be dismantled and then reconstructed on a site a short distance from Chicago and that a 1000-kw plutonium plant should be built at Clinton, Tenn.

The Scale of Production

The first decision to be made was on the scale of production that should be attempted. The figure decided upon cannot be disclosed here but it was very large.

As was indicated in the preceding article, the production of one gram of plutonium per day corresponds to a generation of energy at the rate of 500 to 1500 kw. Therefore, a plant for large scale production of plutonium will release a very large amount of energy. The problem, therefore, was to design a plant of this capacity on the basis of experience with a pile that could operate at a power level of only 0.2 kw. As regards the plutonium separation work, which was equally important, it was necessary to draw plans for an extraction and purification plant which would separate some grams a day of plutonium from some tons of uranium, and such planning had to be based on information obtained by microchemical studies involving only a half a milligram of plutonium. To be sure there was information available for the design of the large scale-pile and separation plant from auxiliary experiments and from large scale studies of separation processes using uranium for a stand-in for plutonium, but even so the proposed extrapolations both as to chain reacting piles and as to separation processes were staggering. In peacetime no engineer or scientist in his right mind would consider making such a magnification in a single stage and even in wartime only the possibility of achieving tremendously important results could justify it.

As soon as it had been decided to go ahead with large scale production of plutonium, it was evident that a great expansion of organization was necessary. The Stone & Webster Engineering Corp. had been selected as the over-all engineering and construction firm for the project soon after the Manhattan District was placed in charge of construction work. By October, 1942, it became evident that various component parts of the work were too far separated physically and were too complicated technically to be handled by a single company, especially in view of the rapid pace required. Therefore, it was decided that it would be advantageous if Stone & Webster were relieved of that portion of the work pertaining to the construction of plutonium production facilities. This was done, and General Groves selected the E. I. du Pont de Nemours & Co. as the firm best able to carry on this phase of the work. The du Pont Co. in accepting the undertaking insisted that the work be conducted without profit and without patent rights of any kind accruing to them. A cost-plus-a-fixed-fee contract between the Government and du Pont established a fixed fee of one dollar.

The specific responsibilities assumed by du Pont were to engineer, design and construct a small-scale semi-works at the Clinton Engineer Works in Tennessee and to engineer, design, construct and operate a large-scale plutonium production plant of large capacity at the Hanford Engineer Works in the Sate of Washington.

Inasmuch as du Pont was being asked to step out of its normal role in chemistry into a new field involving nuclear physics, it was agreed that it would be necessary for them to depend most heavily upon the Metallurgical Laboratory of the University of Chicago for fundamental

ATOMICS

research and development data and for advice.

In considering the large scale production plant, it was conceivable that conditions might arise under which a large pile might spread radioactive material over a large enough area to endanger neighboring centers of population. In addition, there remained the requirement of a large power supply. To meet these two requirements a site was chosen and acquired on the Columbia River in the central part of the state of Washington near the Grand Coulee power line. This site was known as the Hanford Engineer Works.

Since the Columbia River is the finest supply of pure cold river water in this country the Hanford site was well suited to either the helium-cooled plant originally planned or to the water-cooled plant actually erected.

At the beginning it was really too early to make a carefully weighed decision as to the best type of plutonium production plant. Yet a choice had to be made so that design could be started and construction begun as soon as possible. Actually a tentative choice was made and then changed.

In November, 1942, the helium-cooled plant was the first choice of the Metallurgical Laboratory. When du Pont came into the picture it at first accepted the proposal of a helium-cooled plant but after further study decided in favor of water cooling. The reasons for the change were numerous. Those most often mentioned were the hazard from leakage of a high-pressure gas coolant carrying radioactive impurities, the difficulty of getting large blowers quickly, the large amount of helium required, the difficulty of loading and unloading uranium from the pile and the relatively low power output per kilogram of uranium metal. Like so many decisions in this project, the choice between various types of plants had to be based on incomplete scientific information. The information is still incomplete but there is general agreement that water cooling was the wise choice.

The Problems of Plant Design

One of the first important problems that had to be solved was to decide on the nature of the lattice used in the pile. The lattices which we have been describing consisted of lumps of uranium imbedded in the graphite moderator. There are two objections to such a type of lattice for production purposes. First, it is difficult to remove the uranium without disassembling the pile; second, it is difficult to concentrate the coolant at the uranium lumps which are the points of maximum production of heat. It was very obvious that both these difficulties could be avoided if a rod lattice rather than a point lattice could be used, that is, if the uranium could be concentrated along lines passing through the moderator instead of being situated merely at points. There was little doubt that the rod arrangement would be excellent structurally and mechanically, but there was real doubt as to whether it was possible to build such a lattice which would still have a multiplication factor k greater than unity. This became a problem for both the theoretical and experimental physicists.

Loading and Unloading

Once the idea of a lattice with cylindrical symmetry was accepted, it became evident that the pile could be unloaded and reloaded without disassembly since the uranium could be pushed out of the cylindrical channels in the graphite moderator and new uranium inserted. The decision had to be made as to whether the uranium should be in the form of long rods which had advantages from the nuclear physics point of view or of relatively short cylindrical pieces which had advantages from the point of view of handling. In either case, the materials would be so very highly radioactive that unloading would have to be carried out by remote control and the unloaded uranium would have to be handled by remote control from behind shielding.

The question of possible corrosion involved important decisions. If water was to be used as a coolant it would have to be conveyed to the regions where heat was generated through channels of some sort. Since graphite pipes were not practical, some other type of pipe would have to be used, but the choice of the material for the pipe like the choice of all the other materials to be used in the pile, was limited by nuclear physics considerations. The pipes must be made of some material whose absorption cross-section for neutrons was not large enough to bring the value of k below unity. Furthermore the pipes must be made of materials which would not disintegrate under the heavy density of neutron and gamma radiation present in the pile. Finally, the pipes must meet all ordinary requirements of cooling system pipes. They must not leak, they must not corrode, they must not warp.

From the nuclear physics point of view, there were seven possible materials. Lead, bismuth, beryllium, aluminum, magnesium, zinc, and tin. None of these had high neutron-absorption cross-sections. No beryllium tubing was available and of all the other metals only aluminum was thought to be possible from a corrosion point of view. But it was by no means certain that aluminum would be satisfactory and doubts about the corrosion of the aluminum pipes were not settled until the plant had actually operated for some time.

The most efficient cooling procedure would have been to have the water flowing in direct contact with the uranium in which the heat was being produced. Indications were that this was probably out of the question because the uranium would react chemically with the water at least to a sufficient extent to put a dangerous amount of radioactive material into solution and probably to the point of disintegrating the uranium slugs. Therefore, it was necessary to find some method of protecting the uranium from direct contact with the water. Two possibilities were considered. One was some sort of coating either by electro-plating or dipping the other was sealing the uranium slug in a protective jacket or can. Strangely enough this canning problem turned out to be one of the most difficult problems encountered in such piles. No one who lived through the period of design and construction of the Hanford plant is likely to forget this "canning" problem. On periodic visits to Chicago one could roughly estimate the state of the canning problem by the atmosphere of gloom or joy to be found around the laboratory. Cans made of aluminum were finally used.

Water Supply

The problem of dissipating thousands of kilowatts of energy was by no means a small one. How much water was needed depended of course upon the maximum temperature to which the water could safely be heated and the maximum temperature to be expected in the intake from the Columbia River. Certainly the water supply requirement was comparable to that of a fair sized city. Pumping stations, filtration and treatment plants all had to be provided. Furthermore, the system had to be a very reliable one, it was necessary to provide fast operating controls to shut down the chain reacting unit in a hurry in case of failure of the water supply. If it was decided to use "once through" cooling instead of recirculation, a retention basin would be required so that the radioactivity induced in the water might die down before the water was returned to the river.

Controls and Instrumentation

The control problem was very similar to that discussed in connection with the first chain-reacting pile except that everything was on a larger scale and was, therefore, potentially more dangerous. It was necessary to provide operating controls which would automatically keep the pile operating at a determined power level. Such controls had to be connected with instruments in the pile which would measure neutron density or some other property which indicated the power level. There would also have to be emergency controls which would operate almost instantaneously if the power level showed signs of

(Continued on page 102)

"WINNING" A NUCLEAR ARMAMENT RACE

Scientists Warn Against Dangerous and Misleading Half-Truths

ACCORDING to a recent newspaper column a high government official has said that a nuclear armaments race is under way. Further, the official believed that the United States can "stay ahead" in the race — we can produce more bombs, better bombs, bigger bombs than any other country.

In the long run no country can "win" a nuclear armaments race. It is for this reason that the undersigned scientists, who are familiar with the technological and scientific details of plutonium manufacture, repeat a warning that they have already given many times: In an atomic war the overwhelming advantage lies with the aggressor.

* * *

Because of its inconceivably large destructive power, rather few atomic bombs can be decisive against even a big country. Nuclear armaments, unlike all others, therefore show the phenomenon of saturation. There is little point in manufacturing three times as many bombs as are needed to destroy, say, one-third of the enemy's population. A nuclear armaments race must therefore lead eventually to a state of affairs in which several nations are saturated with atomic bombs. Some nations, such as ours, will saturate earlier; others, which are less highly industrialized and cannot afford such large installations, will saturate later. Eventually all contestants in the armaments race have reached saturation; the race in fact ends in a tie, even though some may have more or better bombs than others. To imply that "staying ahead" in the race gives ultimate security is misleading and dangerous.

When saturation in nuclear armaments has been reached it is as though two men (who don't trust each other) sit face to face in a locked room, each pointing a loaded machine gun at the other. It makes little difference that one man's gun is a later model, or that he has 1,000 cartridges to the other's 100. Whoever shoots first wins decisively.

That every nation, once it succeeds in developing atom bomb know-how, eventually ties in a nuclear armament race, and therefore no single nation will "win" such a race, seems evident to us. There remains the question, will all of the great powers develop this know-how and the industrial installations to back it up?

* * *

England certainly has know-how. The scientific part of the atomic-bomb project was a joint enterprise in which English and Canadian scientists played an important part. Already in Canada there is a pilot plant which will produce plutonium. As for raw materials, the Great Bear Lake uranium ore deposits in northern Canada are among the world's greatest.

France certainly has scientific know-how. Several of the key men in the Canadian project were French emigres who have since visited or returned to France. These men may be presumed to know enough to reproduce with very little effort at least the Canadian pilot plant. France does not have much uranium ore; but Belgium owns enormous deposits in the Belgian Congo. A coalition of France and Belgium has all that is needed to build a plutonium plant.

About Russia we know less. What is known for certain is that the Russians have large uranium ore deposits. Also, the theory of the slow neutron chain reaction (which is used to produce plutonium) was published in Russian scientific journals in 1942. The principles underlying the atomic bomb were published even earlier. Certainly Russian physicists like Kapitza, Joffe, Landau, Tamm, to mention a few, are as competent as physicists anywhere in the world. To assume that they can not reproduce on a scientific level what was done here by a group which was about equally competent is dangerous. On a technological level it is similarly misleading to assume that a country which built the best tanks of World War II cannot compete with us—especially when successful competition means not to build as many bombs as we do, but simply to build to saturation.

* * *

The enormous cost of the atomic bomb, $2,000,000,000, is given by those who believe we can "stay ahead" in the race as proof that other countries can not compete with us. Such a statement is a half-truth which leads only to confusion. In the first place, can we assume that Russia, at least, realizing the stakes involved, would be deterred from building atomic bombs because of their cost? In the second place, the figure of $2,000,000,000 is entirely misleading. Four processes, all of which work, were used to separate U-235 and to manufacture plutonium. According to officially released figures, the plutonium plant at Hanford cost only $400,000,000. Of this a fair fraction went into the construction of the towns of Richland and Hanford. The $2,000,000,000 therefore represents not what atomic bombs need to cost, but rather what they happened to cost us because we had to try several methods for fear some would not work.

The stark reality of the atomic bomb is here to stay. We can not afford to shy away from the reality. We can not afford misleading half-truths about it. When misinformation about the atom bomb stems from high authority, it constitutes a danger of the gravest sort. As American scientists who are in a position to evaluate the accuracy of technological statements concerning the bomb and its production, we urge that we be heard, and that our counsel be considered in this transcendently important matter.

Alvin W. Weinberg
Paul C. Tompkins
Raymond W. Stoughton
Kurt A. Kraps

Oak Ridge, Tenn., Oct. 27, 1945.

(Continued from page 100)

rapid increase or if there was any interruption of the water supply. It was highly desirable that there be some means of detecting incipient difficulty such as the plugging of a single water tube or a break in the coating of one of the uranium slugs. All these controls and instruments had to be operated from behind the thick shielding walls described below.

Shielding

The radiation given off from a pile operating at a high power level is so strong as to make it quite impossible for any of the operating personnel to go near the pile. Furthermore, this radiation particularly the neutrons, has a pronounced capacity for leaking out through holes or cracks in barriers. The whole of a power pile, therefore, has to be enclosed in very thick walls of concrete, steel or other absorbing material. But at the same time, it has to be possible to load and unload the pile through these shields and to carry the water supply in and out through the shields. The shields should not only be radiation tight but air tight since air exposed to the radiation in the pile would become radio active.

The radiation dangers that require shielding in the pile continue through a large part of the separation plant. Since the fission products associated with the production of the plutonium are highly radioactive, the uranium after ejection from the pile must be handled by remote control from behind shielding and must be shielded during transportation to the separation plant. All the stages of the separation plant including analysis must be handled by remote control from behind shields up to the point where the plutonium is realtively free of radioactive fission products.

Maintenance

The problem of maintenance was very simply stated. *There could not be any maintenance inside the shield or pile once the pile had operated.* The same remark applies to a somewhat lesser extent to the separation unit where it was probable that a shut-down for servicing could be effected provided, of course, that adequate remotely controlled decontamination processes were carried out in order to reduce the radiation intensity below the level dangerous to personnel. The maintenance problem for the auxiliary parts of the plant was normal except for the extreme importance of having standby pumping and power equipment available to prevent a sudden accidental breakdown of the cooling system.

Schedule of Loading and Unloading

Evidently the amount of plutonium in an undisturbed operating pile increases with time of operation. Since Pu 239 itself undergoes fission its formation tends to maintain the chain reaction while the gradual disappearance of the U 235 and the appearance of fission projects with large neutron absorption cross-sections tends to stop the reaction. The determination of when a producing pile should be shut down and the plutonium extracted involves a nice balancing of these factors against time schedules, material costs, separation process efficiency, etc.

General Nature of the Separation Plant

As has already been pointed out the slugs coming from the pile are highly radioactive and, therefore, must be processed by remote control in shielded compartments. The general scheme followed was suggested in the latter part of 1942, particularly in connection with plans for the Clinton Separation Plant. This scheme was to build a "canyon" which would consist of a series of compartments with heavy concrete walls arranged in a line and almost completely buried in the ground. Each compartment would contain the necessary dissolving or precipitating tanks or centrifuges. The slugs would come into the compartment at one end of the canyon, they would then be dissolved and go through the various stages of solution, precipitation, oxidation or reduction, being pumped from one compartment to the next, until a solution of plutonium free from uranium and fission projects came out in the last compartment. As in the case of the pile, everything would be operated by remote control from above ground, but the operations would be far more complicated than in the case of the pile.

It is not feasible in this abstract of the Smyth report, to discuss in detail many of the problems that were involved in the design and construction of the Hanford Plant. The problems of waste disposal, for example, the problem of the recovery of uranium, the effect of radiation on chemical reaction, the health problem, and the protection of personnel against the effects of radiation. All of these required an immense amount of research and study.

The necessity for pushing the design and construction of the full scale plutonium plant simultaneously with research and development inevitably led to a certain amount of confusion and inefficiency. It became essential to investigate many alternative processes. It became necessary to investigate all possible causes of failure even when the probability of their becoming serious was very small. Now that the Hanford Plant is producing plutonium successfully, it is fair to say that a large percentage of the results of investigation made between the end of 1942 and the end of 1944 will never be used, at least not for the originally intended purposes. Nevertheless, had the Hanford Plant run into difficulties any one of the now superfluous investigations might have furnished just the information required to convert failure into success. Even now, it is impossible to say that future improvements may not depend on the results of researches that seem unimportant today.

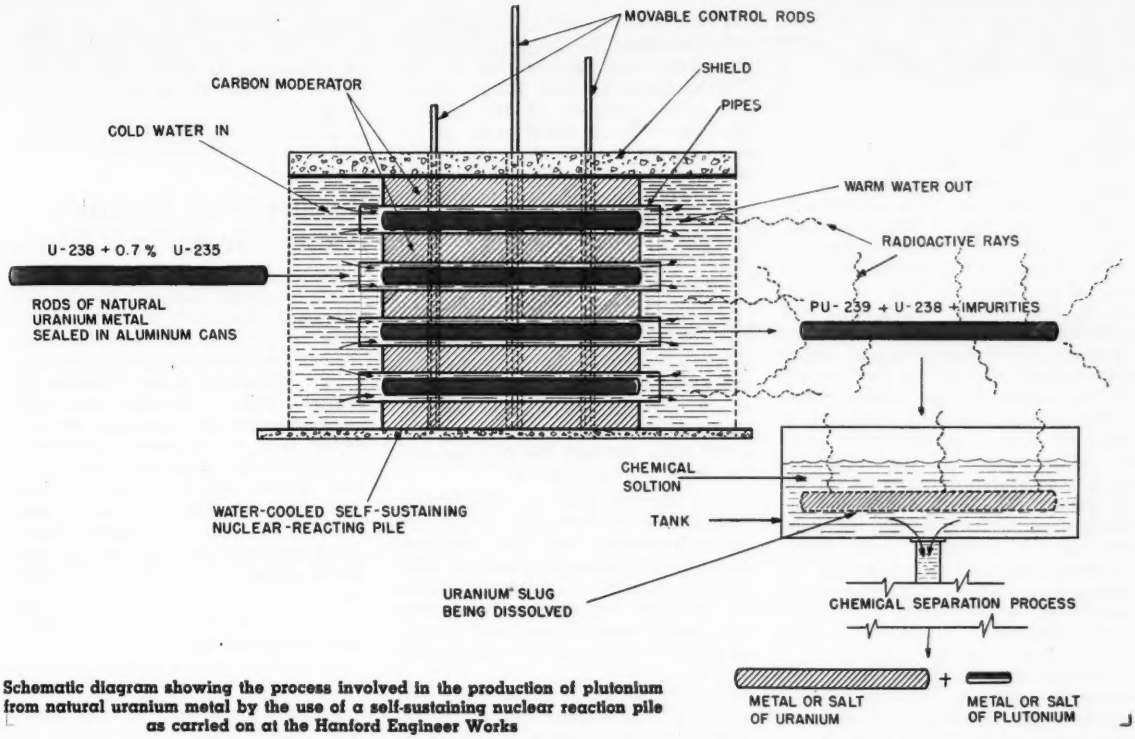
It is estimated that thirty volumes will be required for a complete report of the significant scientific results of researches conducted under the auspices of the Metallurgical Project.

It is also beyond the scope of this article to give even a brief account of the construction of the Hanford Engineer Works, but a few details can be given. The Hanford site was examined by representatives of General Groves and of du Pont at the end of 1942, and use of the site was approved by General Groves after he had inspected it personally. It is on the west side of the Columbia River in central Washington, north of Pasco. In the early months of 1943 a 200-square-mile tract in this region was acquired by the Government through the real estate division of the Office of the Chief of Engineers. Eventually, an area of nearly a thousand square miles was brought under Government control. On the 6th of April, 1943, ground was broken for the Hanford construction camp. At the peak of activity in 1944, this camp was a city of 60,000 inhabitants, the fourth largest city in the state. Now, however, the camp is practically deserted as the operating crew is housed at Richland.

Work was begun on the first of the Hanford production piles on June 7, 1943, and the operation of the first pile began in September, 1944. The site was originally laid out for 5 piles but the construction of only 3 has been undertaken. Besides the piles there are, of course plutonium separation plants, pumping stations and water treatment plants. There is also a low-power chain reacting pile for material testing. Not only are the piles themselves widely spaced for safety several miles apart, but the separation plants are well away from the piles and from each other. All 3 piles were in operation by the summer of 1945.

As already mentioned, the problem of canning, that is the problem of sealing the uranium slugs in protective metal jackets, was one that involved many difficulties. It was definitely not a simple matter to find a sheath that would protect uranium from water corrosion, would keep fission products out of the water, would transmit heat from the uranium to the water, and would not absorb too many neutrons. Yet the failure of a single can might conceivably require shut down of an entire operating pile.

Attempts to meet the stringent requirements involved experimental work on electro-plating processes,



Schematic diagram showing the process involved in the production of plutonium from natural uranium metal by the use of a self-sustaining nuclear reaction pile as carried on at the Hanford Engineer Works

hot-dipping processes, cementation-coating processes, corrosion-resistant alloys of uranium, and mechanical jacketing or canning processes. Mechanical jackets or cans of thin aluminum were feasible from the nuclear physics point of view and were chosen early as the most likely solution of the problem. But the problem of getting a uniform heat conducting bond between the uranium and the surrounding aluminum and the problem of affecting a gas tight enclosure for the cans both proved very troublesome. Development of an alternative method had to be carried along up to the last minute and even up to a few weeks before it was time to load the uranium slugs into the pile, there was no certainty that any of the processes under development would be satisfactory. A finally minor, but apparently important modification in the preferred canning process was adopted in October, 1944, after the first pile had begun experimental operation. By the summer of 1945, there had been no can failure reported.

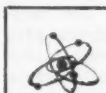
During the fall of 1944 and the early months of 1945, the second and third Hanford piles were finished and put into operation as were the additional chemical separation plants. There were, of course, some difficulties, however, none of the fears expressed as to canning failure, film formation in the water tubes, or radiation effects in the chemical processes have turned out to be justified. As of early summer 1945, the piles were operating at design power, producing plutonium and heating the Columbia River. The actual rise of temperature in the river, however, is so tiny that no effect on fish life could be expected. To make doubly sure this expectation was confirmed by an elaborate series of experiments.

The operation of the chain reacting piles at Hanford, however, constitute only one part of the process. The other part involves the separation of the plutonium from the uranium slugs in which it is formed.

The uranium slugs containing plutonium also contain other elements resulting from the fission of U 235. When a U 235 nucleus undergoes fission, it emits one or more neutrons and splits into two fragments of comparable size and of total mass 235 or less. Apparently fission into precisely equal masses rarely occurs. The most abundant fragment being a fragment of mass number between 134 and 144 and a fragment of mass number between 100 and 90. Thus there are two groups of fissions products, a heavy group with mass numbers extending approximately from 127 to 154 and a light group from approximately 115 to 83. These fission products are in the main unstable isotopes of the 30 or so known elements in the general range of mass number.

In addition to radioactive fission products, U239 and NP239 (Neptunium) are present in the pile and are radioactive. The concentration of all these products begins to build up at the moment the pile starts operating. Eventually the rate of radioactive decay equals the rate of formation so that the concentrations become constant. For example, the number of atoms of U239 produced per second is constant for a pile operating at a fixed power level. According to the laws of radioactive disintegration the number of U239 atoms disappearing per second is proportional to the number of such atoms present and is thus increasing during the first few minutes or hours after the pile is put into operation. Consequently, there will soon be practically as many nuclei disintegrating each second as are formed each second. Equilibrium concentrations for other nuclei will be approached in similar manner, the equilibrium concentration being proportional to the rate of formation of the nucleus and to its half life. Products which are stable or of extremely long half life (e.g., plutonium) will steadily increase in concentration for a considerable time. When the power is stopped the radioactivity of course continues but at a continually diminishing absolute rate. Isotopes of very short half life may drop out of sight in a few minutes or hours. Others of longer half-life keep appreciably active for days or months. Thus at any time the concentrations of various products in a recently stopped pile depend on what the power level was, how long the pile ran, and how long it has been shut down.

In the choice of a chemical separation process, therefore, the problem is to make a chemical separation at the daily rate of, say, several grams of plutonium from several thousand



ATOMICS

grams of uranium, contaminated with large amounts of dangerously radioactive fission products comprising 20 different elements. This problem is especially difficult as the plutonium purity requirements are very high.

Four types of methods for chemical separation were examined; volatility, absorption, solvent extraction, and precipitation. These four separating processes were described and shown diagrammatically in the first article of this series in the October issue.

The process finally developed at Hanford was a precipitation process. The success of the separation project at Hanford exceeded all expectations. The high yields and decontamination factors and the relative ease of operation, have amply demonstrated the wisdom of its choice as a process. This choice was based on a knowledge of plutonium chemistry which had been gleaned from less than a milligram of plutonium. Further developments may make the present Hanford process obsolete, but the principal goal, which was to have a workable and efficient process for use as soon as the Hanford piles were delivering plutonium, had been attained.

The Argon Laboratory

Concluding this discussion of the plutonium plant at Hanford a few words about the Argon Laboratory just outside Chicago may be of interest. Argon Laboratory was constructed early in 1943. The site originally intended for a pilot plant was later considered to be too near the city and was used for reconstructing the so-called West-Stands pile which was originally built on the University of Chicago grounds, described in the November issue.

The first Argon pile, a graphite uranium pile, need not be described in detail. The material and lattice structure are nearly identical to those which were first used for the original West-Stands pile. The pile is a cube. It is surrounded by a shield and has control and safety devices somewhat similar to those used later at Clinton. It has no cooling system and is normally run at a power level of only a few kilowatts. It has occasionally been run at high power levels for very brief periods. Considering that it is merely a reconstruction of the first chain reacting unit ever built, it is amazing that it has continued in operation for more than two years without developing any major troubles.

More recently a pile using heavy water as moderator was constructed in the Argon Laboratory. The very high intensity beam of neutrons produced by this pile has been found well suited to the study of neutron optics, that is, reflection and refraction of neutron beams as by graphite.

A pilot plant for the production of plutonium was also erected at the Clinton plant at Oak Ridge, Tenn. The main purposes of the Clinton plant were to produce some plutonium and to serve as a pilot plant for chemical separation. The Clinton pile consists of a cube of graphite containing horizontal channels filled with uranium. Uranium is in the form of metal cylinders protected by gas tight casings of aluminum. The uranium cylinders or slugs may be slid into the channels in the graphite. Space is left to permit cooling air to flow past and to permit pushing the slugs out at the back of the pile when they are ready for processing. Besides the channels for slugs there are various other holes through the pile for control rods, instruments, etc.

The Clinton pile is considerably larger than the first pile at Chicago. More important than the increased size of the Clinton pile were its cooling system, heavier shields and means for changing the slugs. The production goal of the Clinton plant was set at a figure which meant that the pile should operate at a power level of 1000 kw. In spite of an impressive array of instruments and safety devices, the most striking feature of the pile is the simplicity of operation. Most of the time the operators have nothing to do except record the readings of the various instruments.

The Clinton Pile Operated at 1800 kw

The Clinton pile started operating on November 4, 1943, and within a few days was brought up to a power level of 500 kw at a maximum slug surface temperature of 110 degrees Centigrade. Improvements in the air circulation and an elevation of the maximum uranium surface temperature to 150 degrees Centigrade, brought the power level up to about 800 kw where it was maintained until the spring of 1944. Starting at that time a change was made in the distribution of uranium, the change being designed to level out the power distribution in the pile by reducing the amount of metal near the center relative to that further out. And thereby to increase the average power level without anywhere attaining too high a temperature. As a result a power level of 1800 kw was attained in May, 1944, this was further increased after the installation of better fans in June, 1944.

In the meantime, the development of the separation process at Clinton went on and the separation process worked. The first batch of slugs from the pile entered the separation plant on December 20, 1943. By the end of 1944, metal from the pile was going to the separation plant at the rate of one-third ton per day. By February 1, 1944, 190 milligrams of plutonium had been delivered and by March 1, 1944 several grams had been delivered. Furthermore the efficiency of recovery at the very start was 50 per cent and by June, 1944, it was between 80 and 90 per cent.

Editor's Note: This is the third of a series of articles on this subject. A fourth will appear in the January issue.

Russia Will Produce Atomic Bomb in 3 Years

REGARDING RUSSIA'S position in the atomic energy picture, Dr. Irving Langmuir, Associate director of the General Electric Co. Research Laboratory, who recently returned from Russia presented some illuminating remarks before a Senate investigating committee not long ago. He predicted that if an atomic armament race develops Russia will produce its first atomic bomb in about three years and possibly accumulate them "far faster" than the United States. Dr. Langmuir gave six reasons why the Russians would have an adcantage:

(1) "A larger population, and it can be regimented.

(2) "They have a remarkable system of incentive which is rapidly increasing the efficiency of their industrial production.

(3) "No unemployment.

(4) "No strikes.

(5) "They have a deep appreciation of pure and applied science.

(6) "They have already planned a far more extensive program in science than any contemplated by us."

"We must consider also that Russians have continued the training of scientists during the war to a far greater extent than we have," the chemist said. "Furthermore, they have available in any atomic energy program the knowledge and technical skill of German scientists and technicians.

"Russia certainly has ample resources in uranium."

Langmuir testified that if Russia considered the incentives great enough, she could mobilize her resources for an atomic energy program, get her people to forego a higher standard of living and devote 10 per cent of her production capacity to a five-year atomic energy plan.

In contrast, he said, before the war the United States devoted only .04 per cent of its national income to research. This rose to about .5 per cent during wartime.

Langmuir proposed that the governments of Great Britain, Canada an dthis nation seek immediate contact with the Soviet government to secure a tentative agreement based King formula of Nov. 15.

The PRACTICAL ENGINEER and ELECTRICIAN

ANDREW W. KRAMER, EDITOR

Wanted, A Cure for the Itch

Several months ago, writes a subscriber, we tried out the new spun glass insulation on our refrigeration lines and brine tanks. The pipe people all argued that we would need 6 in. of this insulation; We only put on 2 in., however, and it seems to be ample. The advantage of this insulation over other types is that it can be used on lines subject to both heat and cold.

We bumped into one difficulty, however. The crew we hired to cut and apply this insulation complained of the itch; not only on their hands, but all over their body. The tiny particles of glass evidently powder off in the sawing and fitting operations. Have the glass insulation people worked out any practical suggestions for preventing this type of "workman's itch"? It would be to the advantage of manufacturers of this type of insulation to tell us more about application kinks. What say, Manufacturers?

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When Boilers Overheat

A short discussion about what happens when power boilers overheat together with photographs as reported in a recent issue of The Locomotive published by The Hartford Steam Boiler Inspection and Insurance Company

EACH YEAR there are hundreds of serious cases of overheated boilers, and usually the cause of such accidents is low water. Because there is little water left in the boilers, occurrences of this kind are generally not violent even though the metal of the boiler may burn completely through. The result, therefore, is not an explosion; there is overheating, and it is often accompanied by severe burning and bulging. The loss to the owner consists, then, of repair or replacement costs, plus any indirect losses caused by the interruption of business. These losses are frequently very large.

In some cases, of course, the construction of the boiler is such that overheating results in a violent occurrence. This often happens with boilers of the locomotive firebox type where it is possible to have a substantial volume of water remaining in some parts of the boiler at the same time that other parts that are exposed to the fire are lacking sufficient water.

It must not be presumed, therefore, that "low water" accidents are always unspectacular, nor, conversely, is it true that the principal cause of boiler explosions is "low water." The cases that follow will make this clear and will show, also, that failure to maintain sufficient water in a boiler may be very expensive, whether or not an explosion results.

The first case concerns a water tube boiler used to provide process steam in a dairy. When the night operator found that he was unable to get steam, he called the plant engineer at his home, reporting that everything seemed all right except for the lack of steam. The engineer hastened to the plant and found that there was no water showing in the gage glass. Peering into the furnace through the fire door he saw a startling sight—molten metal dripping into the firebox. He immediately shut down the stoker, but $5,000 worth of damage had already been done.

A picture accompanying this article shows how the tubes of the boiler looked after they had cooled down enough for the photographer to get near them. The boiler was supposedly safeguarded against accidents of this kind by an automatic water feeder and low water fuel cut-off. These devices were inoperative, however, due to lack of maintenance. The pipe between the water column and the automatic controls was clogged with scale and sediment. Even under such circumstances, a competent operator should have been able to detect the early symptoms of trouble and thus

Fig. 1. (Above) Bulging or collapse of a corrugated furnace of a Scotch marine boiler. The low water fuel cut-off failed to shut down the stoker at a time when low water actually existed. This was an expensive accident even though there was no explosion

Fig. 2. (Left) Another case of severe bulging in a corrugated furnace of a Scotch marine boiler that resulted from overheating following a low water condition. Automatic fuel and water controls failed to function. Note that there was no rupture of the shell

Fig. 3. This picture shows what burned tubes in a water tube boiler can look like if automatic controls fail to work and an incompetent operator is handling the boiler. Repair cost exceeded $5000

prevent the serious accident that happened.

Another accident involved a comparatively small water tube boiler in a cleaning and dyeing establishment. Oil fuel had been used originally, but later a coal stoker was substituted. Possibly at the time of this change-over, somebody rearranged the mechanism of the low water fuel cut-off so that it functioned as a high water cut-off, and later, when a deficiency of water developed in the boiler, the protective device that should have shut down the stoker failed to do so. The front steam drum was warped, and leakage developed at most of the tube ends. While this was not a severe case of burning, the repair costs exceeded $900, and the loss of production amounted to nearly $1,400.

A dairy was more fortunate than the cleaning and dyeing plant just mentioned, in that the dairy had a spare boiler it could use. It had to fire up the spare when the corrugated furnace of its 72 in. Scotch marine boiler collapsed. Oil fuel was used, and it was found that the boiler operator, who also helped with the bottle washing, relied almost entirely on the automatic cut-off and pump switch to take care of the firing of the boiler and the water level. This combination control failed to work one morning, and severe bulging resulted.

Another case of furnace collapse, or bulging, occurred in connection with a 90 in. Scotch marine boiler used at an asphalt plant. This was a coal-fired boiler using a stoker and, like the accident just described, the occurrence was caused by failure of automatic controls following the development of a low water condition. The low water fuel cut-off was connected to the water column, and a nipple in the connection was clogged with scale. This led to a false level as shown by the gage glass and prevented the cut-off from responding at the proper time. Repairs were estimated to cost more than a replacement boiler, and the latter was eventually installed at a cost of nearly $2,500.

In the four cases mentioned thus far, there were no explosions, merely severe overheating and distortion. In the three that follow, explosions succeeded the initial occurrence of overheating.

The first accident happened in connection with a boiler of the economic type used at a cleaning and dyeing plant. Operators had noticed a peculiar odor in the steam coming from the presses, and two of the men had started for the boiler room to investigate. The boiler exploded just before they reached the door of the boiler house and they actually saw the explosion and survived to describe it.

Their report indicates that they heard the feed pump start up just as they approached the boiler house, and within a few seconds the explosion occurred. The force of this was ap-

Fig. 4. Low water led to overheating of the shell of this fire tube economic type boiler. Delayed starting of the automatic feed pump then introduced water into the overheated shell and the rupture occurred

parently directed in large part to the rear of the boiler where flames are said to have shot out 40 ft.

A new feed pump had been installed for use with this boiler the day before the accident, and as nearly as can be determined, some fault in the control mechanism delayed the starting of the pump until the water level was below the bottom of the shell. The latter then overheated to the extent that when water was finally introduced, it came in contact with the overheated shell and led to the explosion. The property damage loss was estimated at $5,000.

Another case of an explosion following a low water condition occurred in connection with a locomotive firebox type boiler using oil fuel. The controls for this boiler were not automatic but were dependent upon an operator who was supposed to be on the job at all times when the boiler was in use. One day he fell asleep during an extended period of overtime work. His awakening came when the boiler exploded. The crown sheet had overheated, collapsed, and torn loose from its stay-bolts. The oil burner was knocked out of the furnace by the explosion, but because the flame was not extinguished the burner sprayed fire all over the place. The damage resulting from the two occurrences of explosion and fire amounted to more than $5,000.

The last case in this account is one in which low water led to overheating which caused severe bulging of the shell of a horizontal tubular boiler. The bulge finally ruptured with considered force, although the small amount of water that was in the boiler limited the violence of the explosion. It was difficult to determine the exact cause of this accident due to conflicting statements of operators, but it seems likely that the water column connections were obstructed, producing a false reading of the gage glass, and that operators were lax in testing the try cocks and the water column. The- property damage exceeded $6,500.

PRACTICAL HINTS AND KINKS

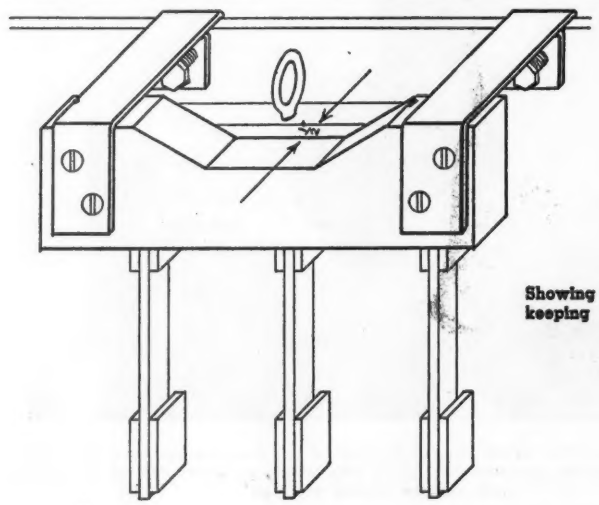
Keeping Hot Knife Switches in Service

By Alex Dunajcik

FREQUENTLY knife switches must be kept in service until the contact surfaces become oxidized, thereby causing excessive heating at heavy currents. The temperature of such switches may be substantially lowered if these surfaces could be cleaned, but due to continuity of service it is impracticable to open the switches, and to install temporary jumpers around the switch might involve some unnecessary work. With this thought in mind a device may be made up to permit the movement of contact surfaces upon each other without danger of entirely opening the switch. Such a device is shown in the drawing. A piece of wood is held in front of the switch at a distance of about a half inch by two pieces of strap iron that are clamped to the top of the switch board. These iron straps should be well insulated to prevent damage should they accidentally come in contact with the live parts of the switch. Where the switch is not installed at the top of the board, clamps may be made to extend to the bolts holding the board to the frame-work.

After the clamp is securely in place, the switch is moved back and forth a number of times to loosen the contact surfaces and brighten them by friction upon each other. A light oil should be applied to the edges of contact and worked into the contacts by the movement of the surfaces. This might be repeated after a few days to permit the oil to thoroughly penetrate into the contacts.

This device was used in our plant to reduce the temperature of knife switches that had been in service without an opportunity to clean the switches. The temperature had increased to a point at which the hand could not be held on the blades, but after loosening them the temperature fell to normal. It saved the work of installing jumpers around them so that they might be opened for cleaning or the necessity of shutting down departments that are vitally needed in war production at this time.



Showing arrangement for keeping switch surfaces clean

Cotters

IF COTTERS are spread slightly with a screwdriver or knife blade, as shown, before being inserted in a drilled hole, they will be easier to spread to the full amount afterward.

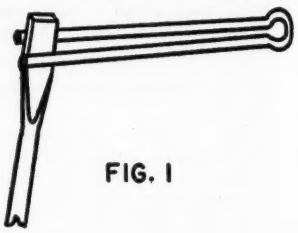


FIG. 1

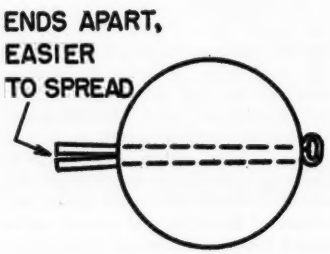
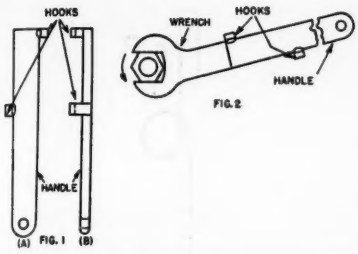


FIG. 2

This is especially important where the cotters are used in locations difficult to reach for final spreading. It is much easier to spread them slightly while held in the fingers.

Leverage Handle for End Wrenches

A COUPLE OF handles, made as shown in the accompanying sketches, will prove very handy to have in the tool or wrench box. They fit over the handles of solid type end wrenches and increase the leverage obtainable for loosening tight bolts and nuts. They should not be used for tightening though since wrench lengths are correctly proportioned for this purpose to prevent stretching the bolt or damaging the threads. Two sizes of handles will fit most wrenches up to one inch opening. If larger wrenches are also used,



additional handles of proper size may be required.

As shown, the handles should be made of sufficiently thick steel stock to provide necessary strength. The hooks that hook over the wrench handles are made of narrower stock and may be either welded or riveted to the handles.

Precautions in Cleaning Stored Machinery

RECONVERSION means that much of the machinery stored for the duration needs cleaning before it can again be used. Plants using organic solvents for this purpose, many of them handling these chemicals for the first time, should take special safety precautions against fire and illness.

Solvent vapors can be injurious to the health. Good ventilation is therefore essential wherever organic solvents are employed. Best procedure is to use properly designed degreasing equipment or a mechanically ventilated spray booth. If a plant which has no such equipment must do a considerable amount of machinery cleaning, it may be advisable to install a special ventilator for handling the solvent vapors. This ventilator may consist of a motor-driven blower which draws the contaminated air from the breathing level and also from the floor level, where the heavy vapor tends to collect. Small parts may be cleaned under a ventilated hood. Such apparatus is not very expensive, and may be used safely when designed and installed under the supervision of a degreasing expert.

If the amount of cleaning is not very great, individual protection for the workers may be provided by means of gas masks. These should be of types approved by the Bureau of Mines for the specific conditions involved. Where the operator is provided with a mask, however, care should be taken that nearby workers are not exposed to solvent vapors, through lack of general ventilation. It may be desirable to carry out cleaning operations after regular working hours, so that only the protected operators are present.

In some cases natural ventilation, outdoors, or in a well-aired room, may be sufficient for small, occasional, cleaning operations. This procedure may not always be safe, however, since weather conditions are variable.

Workers on or near cleaning operations should be instructed to report promptly to the foreman any strong solvent odor. Symptoms of illness, such as nausea, dizziness, headache, stomach or visual disturbances, should immediately be reported to the plant physician or nurse, who must be kept informed of the solvents in use. Some individuals may show unusual sensitivity to solvent vapors, and should be removed from the vicinity of the cleaning operation at once.

Skin troubles may be caused by frequent or prolonged contact with solvents. Where it is not possible to avoid skin contact with solvents, skin difficulties may be prevented by providing workers with protective clothing or creams and good washing facilities.

The chlorinated solvents, such as trichlorethylene, carbon tetrachloride, and perchlorethylene, are not fire hazards, and may be used safely as long as proper ventilation is provided. The petroleum solvents, such as gasoline, benzine, and petroleum ether, on the other hand, are highly flammable, and require extra precautions. Specially designed ventilating equipment, non-sparking tools and shoes, and vapor-proof lights must be provided. Strict observance of "No Smoking" rules and suitable fire extinguishers, conveniently located, are important.

Certain solvent vapors may be corrosive, so that it is not advisable to keep fine machinery in the vicinity of cleaning operations unless there is an efficient ventilating system drawing off the vapors. Otherwise, the machinery should be covered, or the clean-up operation moved elsewhere.

Automatic Window Closer

Worry about rain ruining the living room rug or curtains can be eliminated by an electrical device, scheduled for early production, which opens and closes windows thermostatically. Thus, if the night is hot and there are threatening clouds, it will be safe to leave the house. If the storm strikes, the accompanying drop in temperature will cause the windows to close.

RID THE WORLD OF THESE, FOR PEACE
THE ENEMY MAY BE LISTENING DON'T TALK!
BUY AND KEEP YOUR WAR BONDS
A SLIP OF THE LIP, MAY SINK A SHIP! DON'T TALK
J. A. PATTERSON

"I think it's his Mother-in-Law!"

REFRIGERATING PRACTICE

The Thermoexpansion Valve as It Behaves in Service*

By George Holman

IN SPITE of its small size, the thermoexpansion valve is one of the most complex pieces of equipment in refrigeration service. It is almost as complex as the compressor, opposite which it stands in the refrigeration circuit. It does not have as many moving parts as the compressor. But its parts are weak, more closely adjusted, and the forces which act upon them are comparatively much stronger.

Because of this relationship of size and strength to the forces at work in an operating system, the thermoexpansion valve is much more sensitive to corrosion, erosion, wear and abuse. By using the power applied to compress the refrigerant vapor, the compressor creates and controls such system forces as suction pressure, discharge pressure, superheat and velocity of flow. But the thermoexpansion valve does not create, and does little to control, these forces. Rather, it is controlled by them. Even the so-called power assembly (Fig. 1) is only a device for passively changing the temperature at the feeler bulb into pressure at the diaphragm.

As shown in the diagrammatic sketch, Fig. 2, a thermal actuated expansion valve such as that sketched in Fig. 1 has five forces affecting its operation. Two of these forces, overport pressure, or condenser pressure minus line drop, and underport pressure, or evaporator pressure plus the pressure drop through the distributing nozzle, directly oppose each other through the valve orifice. However, the small size of the usual thermoexpansion valve orifice reduces these forces appreciably. The resultant of overport pressure minus underport pressure is negligible in the average valve of one to two tons capacity.

This leaves three important forces, pressure of the power fluid in the feeler bulb, spring tension and pressure of the refrigerant vapor in the evaporator, which act to motivate the thermoexpansion valve. The pressure of the power fluid acts to open the valve, while spring tension and vapor pressure in the exaporator act to close it. The spring acts directly upon the needle valve, while the evaporator vapor pressure assists the spring by directly opposing the pressure of the

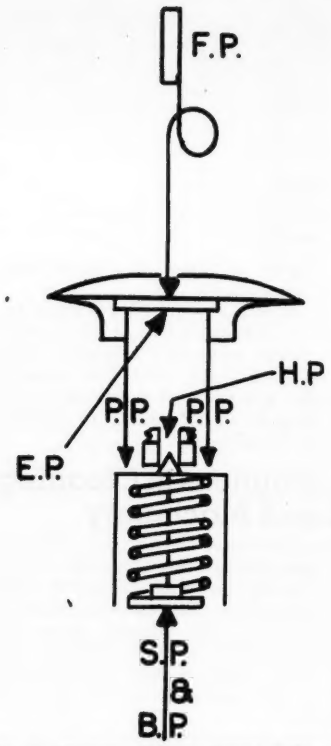


Fig. 2. Diagram showing forces acting on the type of thermoexpansion valve shown in Fig. 1

F.P. Pressure of the power fluid upon the diaphragm tending to open the valve.
P.P. Fluid pressure extending from diaphragm to pin carrier through push pins
H.P. Head pressure (very slight) tending to assist the fluid pressure to open the valve. This is condenser pressure minus drop in liquid line acting through small cross-section of orifice.
S.P. Spring pressure, adjusted by stem to oppose pressure of power fluid.
B.P. Back pressure. This is evaporator pressure plus drop through distributing nozzle. It tends to neutralize head pressure and acts through the orifice only.
E.P. Evaporator pressure. Opposes pressure of power fluid and tends to keep valve closed during cycle

power fluid. At any specific setting of the adjusting stem, spring pressure remains almost constant. Power fluid pressure varies with the temperature of the bulb. While the pressure of the refrigerant vapor in the evaporator varies with the action of the compressor, amount of liquid admitted, rate of evaporation, etc.

If spring tension is at its maximum, as when the adjusting stem is set well up, and if the pressure of the power fluid is low, as when the feeler bulb is very cold, the needle should be firmly against its seat. Assuming no leakage, the valve would pass no refrigerant. As long as the feeler bulb remained cold, the power fluid would not exert enough pressure to open the valve. If the compressor were operating, the evaporator pressure would fall until its approached zero absolute. The differential pressure across

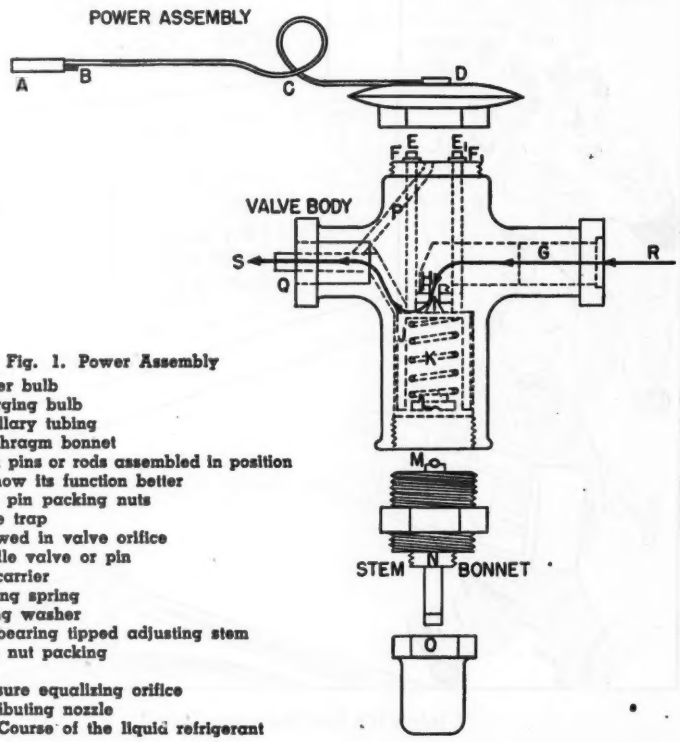


Fig. 1. Power Assembly

a. Feeler bulb
b. Charging bulb
c. Capillary tubing
d. Diaphragm bonnet
e. Push pins or rods assembled in position to show its function better
f. Push pin packing nuts
g. Scale trap
h. Screwed in valve orifice
i. Needle valve or pin
j. Pin carrier
k. Closing spring
l. Spring washer
m. Ball-bearing tipped adjusting stem
n. Stem nut packing
o. Cap
p. Pressure equalizing orifice
q. Distributing nozzle
r to s. Course of the liquid refrigerant

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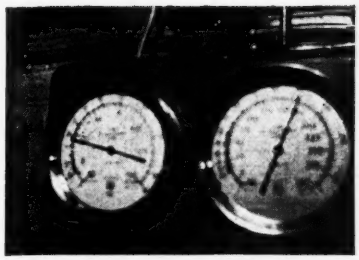


Fig. 3. Whether it is internally or externally equalized, a thermoexpansion valve is influenced far more by suction pressure than by discharge pressure

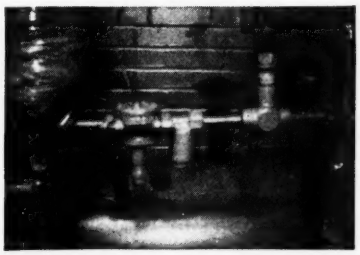


Fig. 4. Thermoexpansion used to operate an air purge is excellently located, with easily accessible scale trap, and with feeler bulb in protected position under the insulation

the valve orifice would probably increase, but normally would not suffice to open the valve.

One or both of two conditions must be met before the valve will open. The pressure of the power fluid must be increased and/or the tension of the spring must be decreased. In normal practice the first occurs automatically with an increase in the temperature of the feeler bulb whenever admission of liquid is checked, and the evaporator warms up. The second is a manual operation of turning the adjusting stem to the left.

With the compressor idle, the evaporator under high vacuum and with spring tension great enough to hold the valve closed against pressure of the power fluid at ambient temperature, turning the adjusting stem to the left eases spring pressure and permits the power fluid to open the valve and admit liquid refrigerant to the evaporator. The liquid quickly evaporates, and the vapor pressure rises. Acting through the equalizer port, this newly formed vapor pressure reaches the underside of the diaphragm and opposes the power fluid pressure on the upper side. The diaphragm moves upward, and the spring closes the valve. Unless the pressure of the power fluid is increased by an increase in temperature of the feeler bulb, no liquid will be admitted until the adjusting stem is turned still further to the left, and spring tension thereby reduced.

Liquid will then pass through the valve again. As it evaporates, the vapor pressure rises still higher in the evaporator. Through the equalizer port the vapor pressure reaches the diaphragm and neutralizes a part of the power fluid pressure. The diaphragm lessens its pressure on the push rods, and the spring, though with less tension, effectively closes the valve. To compensate for the higher evaporator pressure, the stem must again be turned to the left, and the whole procedure repeated.

The pressure to which the saturated vapor of a volatile such as ammonia will rise depends upon the temperature of the evaporator and its surroundings. If the evaporator has a temperature of 30 F, the saturated vapor pressure of ammonia will rise to 45 psi. At this pressure evaporation would cease, if liquid were continuously admitted. But at proper settings, spring tension and vapor pressure combine to keep the valve closed at saturation temperatures and pressures.

This should be the status of an evaporator-thermoexpansion valve evaporative system at the end of the off cycle of the compressor. If the system is simple, that is, containing but one expansion valve, one evaporator, one compressor and one condenser, starting of the compressor is followed by a rapid drop in pressure in the evaporator. Power fluid pressure from the feeler bulb reasserts itself. Spring tension is overcome. The needle valve is pushed away from its seat, and liquid again admitted to the evaporator.

With a constant lower vapor pressure being maintained in the evaporator by the compressor, there is considerable cooling effect by the evaporation of this liquid. To reach the compressor, the cold vapor must pass through the return pipe to which the feeler bulb is clamped. This vapor cools the pipe and bulb. While the low evaporator pressure fails to oppose the power fluid pressure, this power fluid pressure is itself diminished by the lower temperature. Spring tension, though less than ever, again acts to close the valve and check the flow of liquid into the evaporator.

In adjusting a thermoexpansion valve, an ideal setting is reached when, at a constant evaporator pressure, spring tension and total power fluid pressure so oppose each other as to form a balance of power. The spring permits just enough liquid refrigerant to pass to maintain a certain bulb temperature which, in turn, permits just enough power fluid pressure to hold the needle at the same distance from the seat.

However, any variation in evaporator pressure upsets such a balance. Should the vapor pressure fall, the needle would be pushed away from its seat. More liquid would be admitted to the evaporator. But for the facts that at the lower pressure such liquid would evaporate faster, and that more of it would flash into vapor as it passes through the expansion orifice, the evaporator would flood and the liquid might "expand back" to the compressor. Therefore in such cases where the evaporator pressure varies widely it may become necessary to increase spring tension for operation at the lowest pressure prevailing.

Since the quantity of fluid which will pass through a given orifice depends, among other things upon the pressure differential across it, the behavior of a termoexpansion valve also depends upon the head pressure. Liquid temperature is also a factor, since this determines how much of the liquid will flash into vapor when passing through the port. However, these factors are subordinate to the three dominant forces which make the thermoexpansion valve the useful device it is.

Whether a thermoexpansion valve will go from no load to full load without flooding the evaporator depends more upon the type of fluid with which the power assembly is charged than upon any other factor. However, location and size of the bulb, velocity of circulation, evaporator capacity and exposure to radiation from goods in storage, quantity of frost on the evaporator pipes, firmness of bulb contact with the pipe and many other factors influence valve performance.

Factors which put a thermoexpansion valve out of service, or prevent its proper operation, fall into two classes: Those which stop or interfere with the passage of liquid through the valve; and those which permit too much liquid to pass and flood the evaporator. The more important one of the first class are:

Fig. 5. Frost on valve bodies show that these valves are operating, but do not show how well

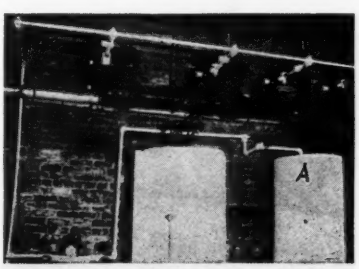


Fig. 6. Liquid passing through the heat exchanger (accumulator) at A leaves a frost trail which shows at once that every one of this battery of thermoexpansion valves is working at capacity

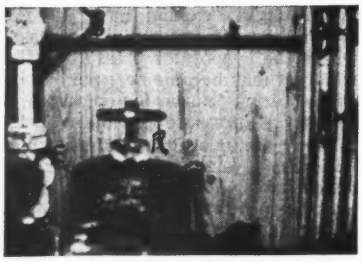


Fig. 7. Frost on the packing nut of the return valve at R reveals the fact that the thermoexpansion valve at E is permitting the evaporator to flood

Fig. 8. Location of the feeler bulb and whether or not it is covered with frost vitally affects thermoexpansion valve performance

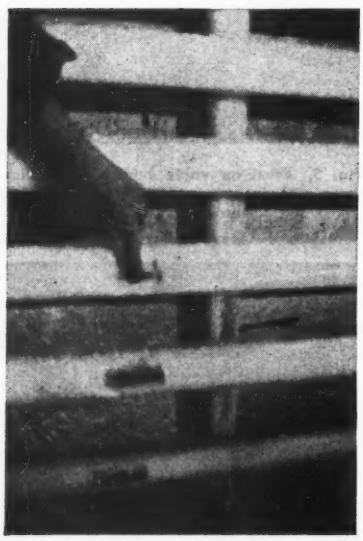


Fig. 9. Setting of the valve may be checked with the stick test. Here two pipes from the top of the evaporator show superheat

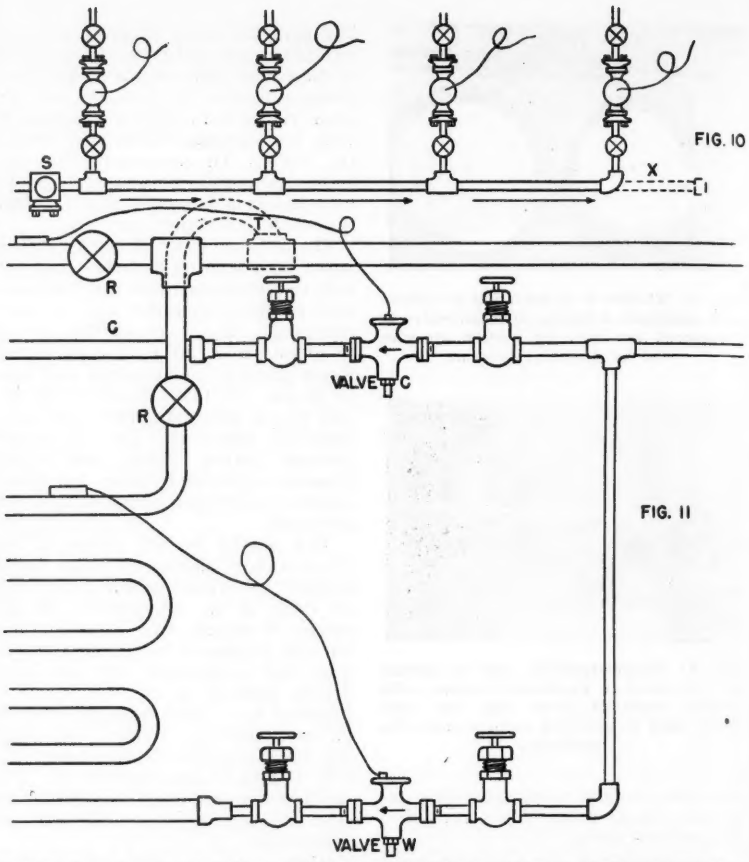


FIG. 10

FIG. 11

Fig. 10. In spite of a scale trap at "S," the end valve of a battery of thermoexpansion valves will clog much more frequently than the other valves. If the ell at "X" is replaced by a tee, and a long nipple sealed with a cap screwed into it, sediment will collect in the nipple and this can be cleaned periodically

Fig. 11. Where evaporators at different levels join the same return line, connections should "gooseneck in" as at "T" and should be joined by a common pipe tee. Without such a gooseneck, liquid from a flooding ceiling evaporator C would flow down into the wall evaporator at "W." This would cool the bulb of valve "W," closing the valve and cutting the small evaporator out of service

1. Power assembly has lost its charge.
2. Power assembly contains wrong charge for operating conditions.
3. Capillary tubing kinked or crushed.
4. Capillary tubing contacting cold pipe, metal, or frozen body.
5. Push rods too short (in type valve shown in Fig. 1).
6. Two gaskets under diaphragm bonnet. (This produces the effect of shortening the push rods by the thickness of one gasket.)
7. Clogged strainer.
8. Valve orifice stopped up.
9. Disturbing nozzle stopped up.
10. Suction pressure too high.
11. Head pressure too low to force enough liquid through orifice.
12. Valve too high above condenser or receiver. (In verticle lines there is a pressure drop due to decreasing static head of the liquid. As liquid flows upward, part of it will evaporate at the lesser pressure, if it is not subcooled, and the vapor will "bind" the valve. This pressure drop per foot approximately equals 0.44 x specific gravity of the liquid. Best solution to this problem is to subcool the liquid to a temperature below that corresponding to saturated pressure at the valves (Photo 4).
13. Too much spring tension.
14. Push rod packing too tight.
15. With internally equalized valves, too high pressure drop through the evaporator.
16. Lack of refrigerant in the system, or system branch.
17. Bulb located over a liquid trap, or low place, in evaporator pipe.
18. Short-circuiting of refrigerant around one or more evaporators in parallel.

Factors which cause a valve to pass too much liquid:

1. Not enough spring tension.
2. Power assembly charged with wrong fluid.
3. Bulb not making good contact with pipe of evaporator.
4. Bulb under warm air current.
5. Push rod packing too tight. (Also causes "cycling.")
6. Push rods too long.
7. Corroded needle and/or seat.
8. Needle and/or seat ground or "polished out." Effect is the same as if push rods are too long.

The Boiler Fireman's Handbook

By J. R. DARNELL

Mechanical vs steam atomization . . . Merits of respective systems . . . Operation of burners with heavy dirty oils . . . Draft . . . Forced draft unnecessary with cold air . . . Importance of steady oil pressure

Part XVII—Fuel Oil Firing—Steam Atomization

IN FUEL OIL FIRING the use of steam (or air) as compared with mechanical atomization is to some extent, a matter of operating conditions, particularly the question of steady versus swinging loads.

Since in most small plants steam is always available whereas compressed air in sufficient quantities, may not be, we will consider only steam atomization when making comparisons with mechanical atomization. Furthermore the higher temperature of steam provides higher combustion efficiency than compressed air unless the latter is heated by special means.

Although many articles have been written on the relative merits of steam and mechanical atomization, it has been the author's experience that when an efficient inside mixing type of burner is used, steam atomization will be found to be the more economical for the small power plant.

Proponents of mechanical atomization argue that mechanical burners are better suited for steady loads and high capacity, whereas steam atomizers are more suitable for swinging loads and lower capacities. They say that when the loss of steam used for atomization is balanced against the cost of the higher pressures and temperatures required for mechanical burners, the net efficiency is almost the same. They do admit, however, that with swinging loads the resultant imperfect atomization with mechanical burners often shows that the net efficiency of steam atomization is equal or superior to mechanical atomization.

In making a comparison between steam and mechanical atomization there are a number of factors to be considered several of which may vary with plant practise for a given type of burner. For example, one manufacturer of both steam and mechanical burners presents data of comparative performance as shown in Table I. Another authority gives a wider latitude for pressures and temperatures, stating that with steam atomization the oil pressure at the burner should be 40 to 60 lb and the temperature 130 F to 190 F. He also states that the oil pressure for mechanical atomization may be from 100 to 250 lb and the temperature 200 F to 280 F.

From the above it is obvious that if the comparison between mechanical and steam atomization were made on the basis of 250 lb oil pressure for the mechanical type but only 60 lb for the steam type while the oil temperatures were to be held at say 250 F for the mechanical types and only 150 F for steam atomization, then the steam atomizers would show as low or lower total steam consumption than the mechanical atomizers.

To prove that the figure of 1.0 per cent steam for atomization is high, reference may be made to Table II showing data compiled by the author during a series of tests run over 20 years ago. Today, oil burners using steam for atomization should be even more efficient.

As shown by Table II, three tests were conducted with each make of the burners shown respectively in Figs. 1 and 2. Both were of the inside mixing type and so far as their relative efficiencies were concerned there was little to choose between them. Each showed an average steam consumption of 0.127 lb steam per lb oil or 0.85 of one per cent of the steam output. Since the fuel oil used averaged about 16 deg Bé and contained considerable free carbon, the burner illustrated in Fig. 1 proved the more satisfactory in daily operation as there was less trouble with this carbon causing clogging of the burner. When the burner shown in Fig. 2 was used the orifices for admission of the oil, is shown in section A-A became clogged with carbon after one day's operation while the burner of Fig. 1

Table I. The data in this table, prepared by a manufacturer of mechanical oil burners, purports to show a comparison in total steam consumption for mechanical and steam atomizing oil burners

Type Burner	Pressures, Lb		Per Cent Steam		Total Steam	Minimum Oil Temp. °F.		Oil Viscosity S. S. F.
	Oil	Steam	For Atomiz.	For Heating and Pumping		No. 6 Grade	No. 3 Grade	
MECHANICAL	250	—	—	1.25	1.25	220	40	20
STEAM	100	100	1.0	0.70	1.70	180	40	40

Table II. This table shows that with two different types of inside mixing steam atomizing oil burners, the steam consumption averaged 0.85 of one per cent of the steam output

Evaporation Tests—Oil Firing with Rated 600 Hp Boiler

Test No.	Gal. Oil 60° F.	Pounds Oil	Pounds Steam for Atom.	Lb Steam Per Lb Oil	Lb Water Equiv. Evap.	Steam for Atomiz. % Output	Per Cent CO_2	Flue Gas Temp. °F.	Per Cent Effic.	Remarks
1	327	2644	332	.126	39241	0.85	13.8	572	76.3	Burner X
2	396	3288	337	.102	46653	0.72	13.2	637	73.0	Burner X
3	256	2028	311	.153	31787	0.98	13.9	550	80.6	Burner X
Av.	326	2653	327	.127	39227	0.85	13.6	586	76.6	Burner X
4	242	2048	280	.137	30130	0.93	12.4	515	75.7	Burner Y
5	362	2894	336	.117	42607	0.79	14.0	592	75.7	Burner Y
6	271	2165	272	.126	33259	0.82	13.2	541	79.1	Burner Y
Av.	292	2369	296	.127	35332	0.85	13.2	549	76.8	Burner Y

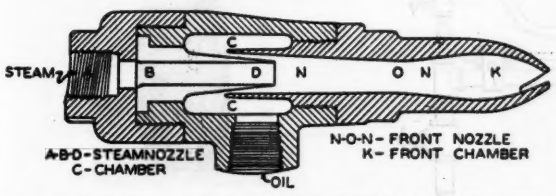


Fig. 1. Simplicity of construction recommends this inside mixing steam atomizing oil burner for dirty fuel oils

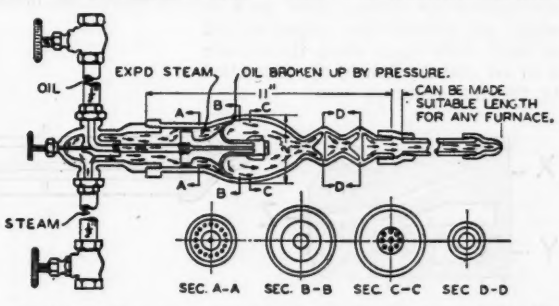


Fig. 2. Less than one per cent of the steam output is used by this burner for atomization but it is not suitable for dirty oil

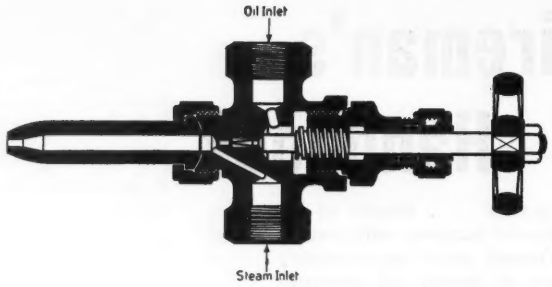


Fig. 3. This inside mixing steam atomizing oil burner, somewhat similar to the one in Fig. 2, is not suitable for dirty oil

would operate for 4 to 5 days without difficulty.

The author's experience, based on actual tests, indicates that steam atomizing oil burners give more satisfactory results, with heavy, dirty oils than can be obtained with mechanical atomizers. Furthermore, in many cases, higher percentages of CO_2 can be obtained with steam when using heavy oils and the overall efficiency is higher in spite of the fact that the steam slightly increases the heat lost in the chimney gases. As shown by Table I in Chapter VII, the pounds of chimney gas per pound oil is increased by 0.5 lb for any given percentage of CO_2.

In Fig. 3 is shown another style of burner of the inside mixing steam atomization type. It uses a needle valve for admission of the oil, similar to that shown in Fig. 2 and, therefore, is not suitable for use with duty oils.

Figure 4 illustrates a steam atomizing burner which although classed as an inside mixing type is really both inside and outside mixing. The oil is admitted through a pipe threaded into the casting at x while the steam enters at y. Oil and steam partially mixed in the small chamber formed between parts a and c but complete mixing is not effected until the oil and steam leave the burner at the orifice z.

In Fig. 5 is shown a burner of the outside mixing type, the oil entering through pipe a and the steam through pipe b. Outside mixing burners generally use more steam and have lower combustion efficiency than those of the inside mixing type.

To obtain the best results from oil burners, if natural draft is used, air for combustion must be admitted with the least amount of resistance. Any air shutter or sliding plate used to admit air around the burner should be kept wide open when the burner is in use and the flow of air controlled by the flue damper.

Forced Draft Unnecessary with Cold Air

Unless preheated air is used for combustion, ordinarily forced draft is unnecessary and uneconomical since the air resistance in flowing from the outside to the point of combustion is very low.

In starting a fire with steam atomizing oil burners, the following points should be observed:

1. Open the flue damper.
2. Bleed condensate from the steam line.
3. Open the steam valve to the burner and allow the burner to warm up.
4. If the oil is at the proper pressure and temperature, gradually open the oil valve or cock with one hand while holding a lighted torch directly below and to the front of the burner tip.
5. After the oil has ignited and the oil and steam valves are adjusted to give a clear bright flame, gradually close the flue damper until the burner produces a long lazy flame but without any appearance of smoke.

If the boiler is not equipped with a CO_2 recorder or device for recording air flow, the fireman should periodically check the quality of the flue gases with a hand Orsat and reconcile such readings with the appearance of the flame for any given adjustment of the oil flow to correspond with a given steam load.

As shown by Table I and Fig. 1 in Chapter VII, 13.5 per cent CO_2 corresponds to about 15 per cent excess air while 14 per cent CO_2 is equivalent to 9.4 per cent excess air. With steady loads the excess air should be maintained between these values.

Steady Oil Pressure Necessary

One of the most important aspects of correct oil firing is maintaining oil

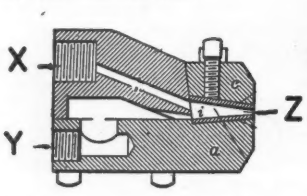


Fig. 4. This oil burner is partly inside and outside mixing with steam atomization

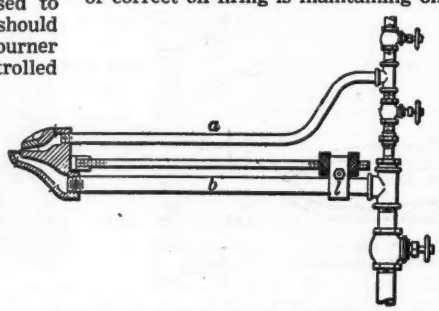


Fig. 5. Here is an outside mixing steam atomizing oil burner

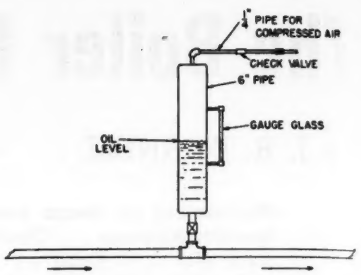


Fig. 6. A simple pressure chamber made of six inch pipe may be used to prevent fluctuations in oil pressure

pressure that does not fluctuate. In many small plants the oil is pumped with reciprocating pumps which often are of the single acting type. Such pumps cause fluctuations in pressure which, in turn, cause variations in length and size of the flame and considerable variation in CO_2.

A simple method of remedying such trouble is to install some sort of air pressure chamber or pulsometer connected to the oil line. As shown by Fig. 6, a piece of six inch pipe about 6 ft long was mounted above a Tee connection in the oil line. A gage glass was attached to the six-inch pipe to observe the oil level. Compressed air was introduced at the top of the six inch pipe to force the oil level down to a point about half way in the gage glass, after which the air was turned off. The air cushion above the oil keeps the pressure at the burners constant.

If the pressure at the burners is in the order of 40 to 60 lb and there is no compressed air available in the plant, a spring type inlet valve such as found in bicycle and automobile tires can be provided at the top of the six inch pipe and by the use of an ordinary band operated automobile tire pump, air can be pumped into the stand pipe.

Another point to be observed in proper oil firing is the provision for dry steam. Many small plants produce steam which is much too wet for proper firing. This trouble can be corrected by providing an efficient type of steam separator such as shown in Fig. 7.

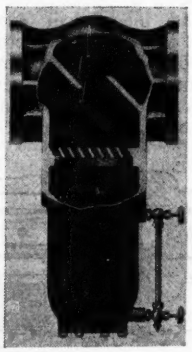


Fig. 7. A steam separator should be used to provide dry steam for oil atomization

The Fundamentals of Electron Tubes

By Ralph B. Immel

Part V. Gaseous tubes . . . Principles of operation . . . Cold cathode tubes . . . Voltage stabilizer glow-tubes . . . Fluorescent lamp glow-tube starter switch . . . Grid-glow tubes . . . Mercury pool cathode tubes . . . Mercury-arc rectifiers . . . Ignitron tubes

Control Engineer, Westinghouse Electric Corporation
East Pittsburgh, Pa.

ALL THE TUBES previously described have had hot cathodes or filaments for electron emission. However, if an inert gas such as argon, neon, or helium is sealed in a two element tube, it is possible to initiate an ionization current of a limited value through the gaseous medium without the necessity of a hot cathode electron emitter. Up to a critical value of voltage across the tube elements there will not be any current flow in the tube. However, when the striking or firing voltage at which the gas becomes ionized is attained, a discharge current passes through the tube and the voltage drop across the tube decreases. For a certain current range the voltage drop across the tube is almost constant regardless of the current flowing through it. Figure 26 shows the characteristic curve of a voltage stabilizer, (or voltage regulator) tube. The input voltage must always be such that the tube fires and a series resistor must be used so that the tube current does not exceed the rating for which the tube was designed. From this curve it can be seen that the voltage drop is almost constant for a wide range of current. At the gas ionization potential, the gas ionization time is in the order of 100 microseconds. An increase in starting voltage may reduce the time to 5 or 10 microseconds. A typical voltage stabilizer tube may operate at 105 volts and be suitable for a current range from 5 to 30 milliamperes. A tube of this rating requires a starting voltage of at least 137 volts.

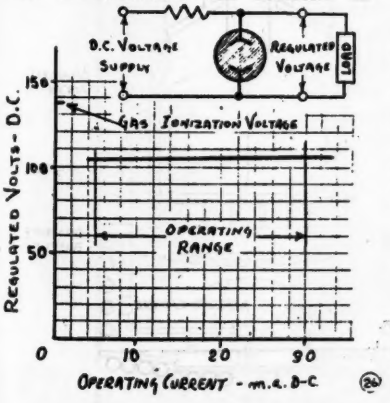


Fig. 26. Characteristic curve of a voltage stabilizer tube

Fluorescent Lamp Glow-Tube Starter Switch

When a critical value of voltage is impressed across the electrodes of the tube shown by Fig. 27, the gas in the tube will be ionized and a current will be conducted through the tube. A typical glow switch may employ a neon-argon gaseous medium which requires approximately 80 volts to initiate the discharge. One of the electrodes in this tube is made of bimetal and is arranged so that when it is heated, it will deflect toward a stationary electrode. The glow discharge current will heat the bimetallic electrode and it will contact the other when it is sufficiently heated. The time delay period or time for the electrodes to make contact is proportional to the discharge current and voltage impressed upon the tube. This device is used as an electronic switch or relay and is widely used as a starting switch for fluorescent lamps. It provides the necessary time delay for the heating of the lamp filaments and also provides a switching action for a reactor unit that will provide a voltage surge of sufficient value to ionize the gas in the lamps. This tube may also be used as a timing element in a motor starter or controller.

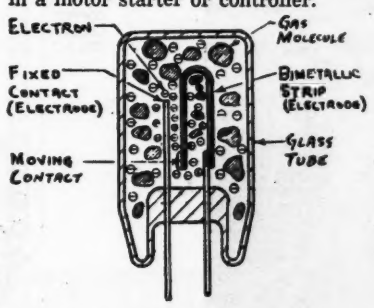


Fig. 27. Fluorescent lamp glow-tube starter switch

Grid-Glow Tube

The addition of a grid to a two element cold cathode gaseous tube provides an extremely sensitive control device. At a critical value of grid voltage as shown by Fig. 28, a discharge will occur between the grid and the cathode. If the anode voltage is high enough, the discharge will immediately transfer from the grid to the anode. The grid and anode voltages may be adjusted so that the application of an extremely small and positive voltage applied to the grid will initiate the discharge. From the curves it can be seen that a change in the external resistance of the circuit will initiate a discharge in the tube if the anode and grid voltages are held constant. This characteristic makes it possible to detect insulation deterioration which may be caused by water, dirt, or fire. It may also be used as a switching device for a photo-electric tube circuit. This tube has often been used in demonstration and protection equipment as it is so sensitive that it can be discharged by the capacity of a person's hand or body when brought into the immediate vicinity of the outer surface of the tube.

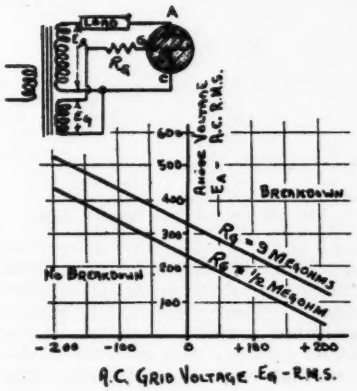


Fig. 28. Characteristics of the grid-glow tube

Mercury Pool Cathode Tubes

For many applications where it is desirable to use an electronic tube capable of delivering a very large value of current or when a tube is needed for controlling a high surge current for a very short duration of time, it is very economical and prac-

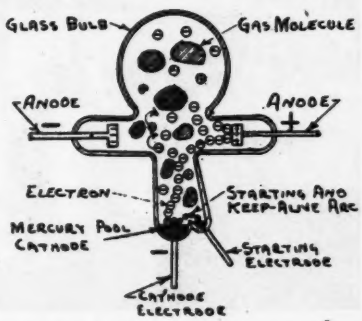


Fig. 29. Typical mercury-arc rectifier tube

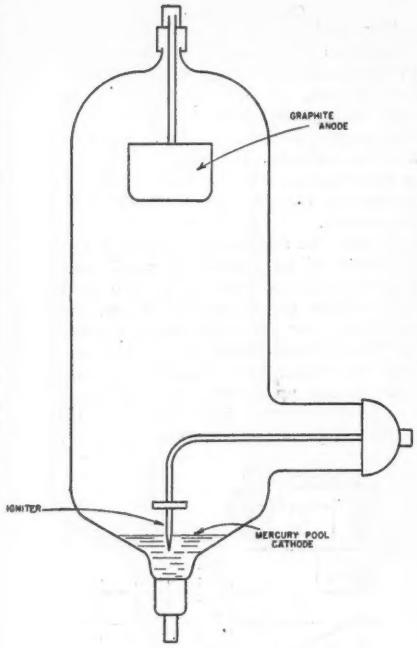


Fig. 30. Sealed type ignitron tube

tical to use a tube with a mercury pool cathode. A filament or oxide coated cathode element in a thermionic emission type of tube cannot withstand currents in excess of the heater capacity and in order to deliver high currents, an impracticably large cathode must be continuously operated at a high operating temperature. A mercury pool cathode can provide a practically unlimited supply of electrons and is widely used in tubes for a-c power conversion and current control in spot and seam welding applications.

Mercury Arc Rectifier

Figure 29 shows a typical mercury arc rectifier tube. In order to start the arc and conduction of current from the mercury pool cathode to the anode, the tube or bulb must be tilted until contact is made between the two mercury pools. Then, when the tube is returned to its normal position, an arc will be drawn on the separation of the two mercury pools. The arc consists of electrons and ions which are rapidly diffused throughout the tube. The mercury vapor in the tube will glow and current can be conducted from a cathode spot on the mercury pool to the anodes similar to the operation of the vacuum or gaseous tube. The cathode spot or place where the electron current stream leaves the mercury pool functions the same as a filament or cathode in a vacuum or gaseous tube; however, it provides an almost unlimited electron emission capacity. The arc can also be started by withdrawing a current conducting ignitron rod from the pool. However, with either starting method a keep-alive-arc must be provided to maintain the arc.

After the arc has once been initiated, additional electrons will be freed and positive ions created by the collisions between the electrons and the gas molecules. Bombardment of the mercury pool and consequent heating of the mercury pool also account from some electron emission. The arc drop across a typical mercury arc tube is from 10 to 20 volts.

A theory which has been presented by Langmuir suggests that the positive ions which are attracted to the negative mercury pool accumulate in a very thin layer at the surface of the mercury. This may create an enormous potential gradient between the ion layer and the pool and may be sufficient to draw the electrons directly out of the mercury by field emission.

Ignitron Tube

The construction of a typical ignitron sealed-off type tube is shown by Fig. 30. This tube functions similar to a mercury arc rectifier once the arc has been started. The arc ignition method is radically different and superior to the mechanical arc starting methods previously discussed. Slepian and Ludwig discovered that a current passing through a carborundum or boron crystal partially immersed in a mercury pool would cause a spark at the junction of the ignitor and the mercury pool which would in turn create a cathode spot. The ignitor functions in the tube as a spark plug does in the cylinder of a gasoline engine.

This ignition method creates the cathode spot and current conduction in a few microseconds. There is no delay when this tube is placed into

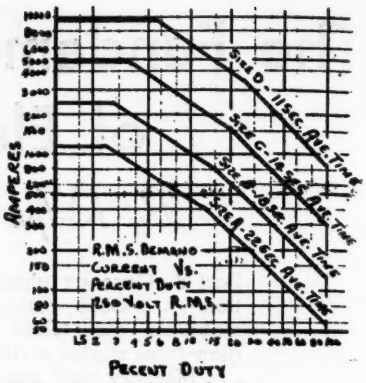


Fig. 31. Typical duty cycles of ignitron tube

Fig. 32. Bank of 12 ignitron tubes built into a 6-phase rectifier

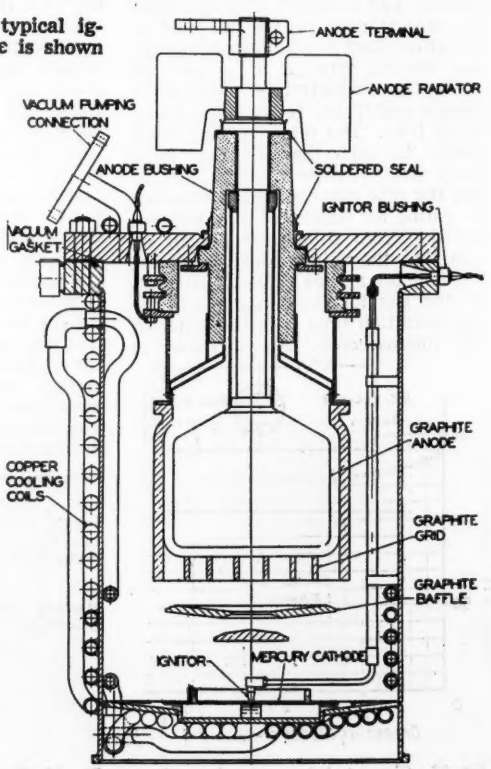
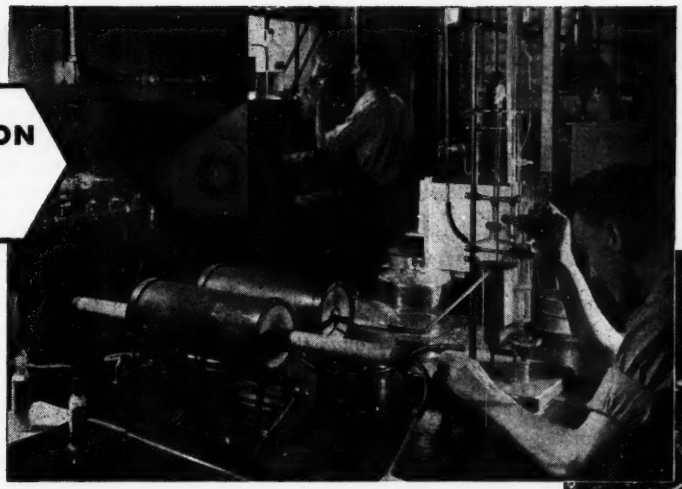


Fig. 33. Cross section of a pumped type ignitron

FROM SELECTION OF RAW MATERIALS



TO FINAL ASSEMBLY

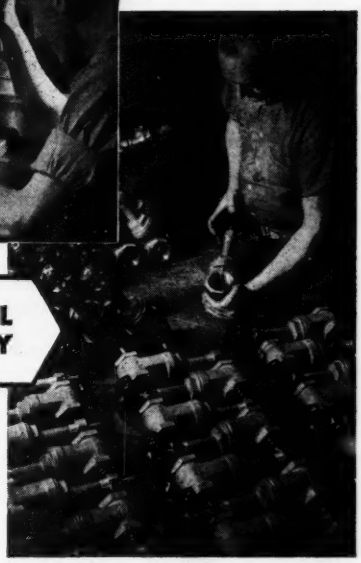


Fig. 2125
Bronze Gate

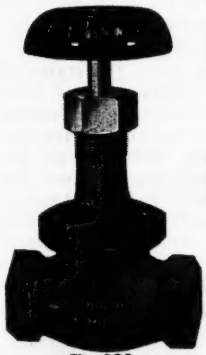


Fig. 123
"N-M-D" Globe
(Non-Metallic Disc)

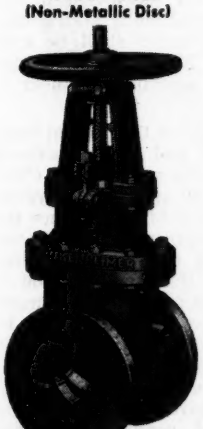


Fig. 1430
Iron
Body Gate

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service. This tube does not require a keep-alive-arc which is usually associated with the conventional mercury pool tubes. After the arc has once been initiated, the tube will conduct current to the end of the particular half-cycle of voltage at which time the reverse line voltage potential will reduce the current to zero and extinguish the arc discharge and cathode spot. The tube must be reignited for further current conduction. This tube can be precisely controlled by relatively small current impulses in the ignitor circuit.

As the current conduction time can be definitely controlled to a fraction of a cycle and as the tube is not limited in frequency of operation as a conventional switch or contactor is limited by inertia of the moving parts, this tube is widely used and is very superior to a single pole contactor for current control in seam or spot welding circuits. Two tubes are usually used so that the a-c power to the welding transformer is continuous. The welding time may be controlled by a synchronous mechanical timing device. This tube is water cooled. Fig. 31 shows typical duty cycles and compares the short time and 100 per cent averaging time current ratings. The duty cycle is a measure of how hard the tube is worked. It expresses the ratio of the current conduction time to a specified period of time known as the averaging time. The averaging time is a fixed time period set by the manufacturer on each type of tube.

The grid controlled mercury arc rectifier which was very widely used a few years ago for substantial power conversion has for the lower voltage ranges almost wholly been supplanted by assemblies of ignitron tubes built into a unit rectifier. One tube is required for each phase. Fig. 32 shows a bank of twelve ignitron tubes built into a six phase rectifier unit. The ignitron power rectifier is better than the conventional grid controlled mercury arc rectifier as the arc drop is much lower which permits the rectifier to be used more economically and with more precise control on low voltage circuits. Also, there is no wasteful energy consumption in the keep-alive-arc, each anode is separated from the other anodes and this helps to prevent flash-overs between phases, and the mechanical construction is relatively simple. In case of trouble the unit tube replacement expense is much lower as the trouble may be segregated to a single tube and not to the complete rectifier. The efficiency of some rectifier units approach 98 per cent which is superior to rotating conversion machinery. It is also quiet. Some ignitron rectifier assemblies have been built for an output of 5000 amperes at 600 volts. Ignitron tubes for substantial power conversion are usually of the pumped type. Figure 33 shows the construction of a pumped type ignitron tube.

LETTERS AND COMMENTS

An Open Letter on the Boilers Act of Alberta

Editor's Note. William S. White who is a frequent contributor to these columns is not satisfied with the administration of the "Boilers Act" in the Province of Alberta, Canada, where he resides. This open letter regarding the act is self explanatory. Although this matter concerns a Canadian province, similar conditions prevail in some of the states in this country and this letter is presented here for comment by the readers on the subject. Most of the states have regulations covering the installation and operation of power plant equipment and it should be of interest to know how well in the opinion of the readers, these regulations are complied with.

I WOULD RESPECTFULLY draw your attention to the Boilers Act of the Province, and its status at the present time. There are a number of things that will bear considering carefully and impartially, believing as you are bound to do, that any laws of the Province should be enforced without fear or favor. The Boilers act as such, has been in existence since Alberta became a Province, and from time to time has been amended, which shows continuity and good reasons for its place on the statute books.

For administrative purposes, there are two bodies of trained personnel. One represented by the Chief Boiler Inspector, and his District Inspectors, who are civil servants, and the other body represented by the Certificated Engineers of various classifications, and who have been purposely chosen by the Government as to practical training, and classified by examinations set of a high standard, which the candidate must pass, before being allowed to operate as an engineer in the Province. That this is so, will be found in the part of the Act, namely, Regulations Governing Engineers an Firemen, and if these regulations are studied as to what the engineer is required to know, before the Government is satisfied with his competence, and that he is suitable to be employed as an engineer by anyone requiring his services, one must admit in the first case, that a high standard of education is required, and that a great deal of study of the subjects enumerated is necessary, besides practical experience, to be recognised by the Government as an engineer. One must conclude in the second place, that the Government intended more, than merely a standard for safety and the prevention of accidents, and further to this, the chief engineer of a power plant, is held totally and solely responsible to the Government for its safe operation and maintenance. It should be evident, that an engineer who has qualified under the Act, has a right to expect that his position, will have the support and protection of the Government in relation to the employer, and the public at large.

It is obvious, that if the Boilers Act is to be properly applied, that it is the responsibility of the Government to maintain sufficient boiler inspectors of a suitable calibre, and sufficiently qualified engineers to meet the demand for such in various classes. The situation as it presents itself, shows that these obligations are not being met. A great deal of substitution of unqualified persons has been, and is being used, to fill positions requiring qualified engineers. This is prostitution of the Act and its intention, which will not stand strict investigation. There would have been no shortage of engineers, or boiler inspectors, if conditions had been maintained as they should have been, the conditions created by the war notwithstanding. Other Provinces it will be found are able to and have kept reasonable conditions, and have used much more discretion.

At the present time, the status of the engineer in Alberta, has been sadly reduced by careless administration, and evident catering to the employers' interests, although as has been pointed out, the engineer has a right to assume a high standard for himself, according to the qualifications demanded by the Government. There are cases of engineers with the proper certificate, who could not obtain a job in their particular classification, although positions were being filled by persons, who had only been issued temporary certificates on the application of the owner of the plant. The Act distinctly states, that such an arrangement shall be cancelled by the Chief Boiler Inspector immediately a qualified engineer is available.

It will be found at the present time, that although it had been considered necessary to have a full time Chief Boiler Inspector in previous years, that for a number of years, since the advent of the present Government, there has been no full time Chief Inspector, and that this position is being filled by a person, with numerous other responsibilities. In fact he is filling positions that ordinarily would be considered separate. The significance of a part time Chief Inspector can be hardly escaped, in light of the present conditions. It can hardly be assumed, that there has been a retraction of activity in the Province, to the extent, that a full time Chief Boiler Inspector is not necessary. In fact it will be found that there is much greater activity, calling for more service on the part

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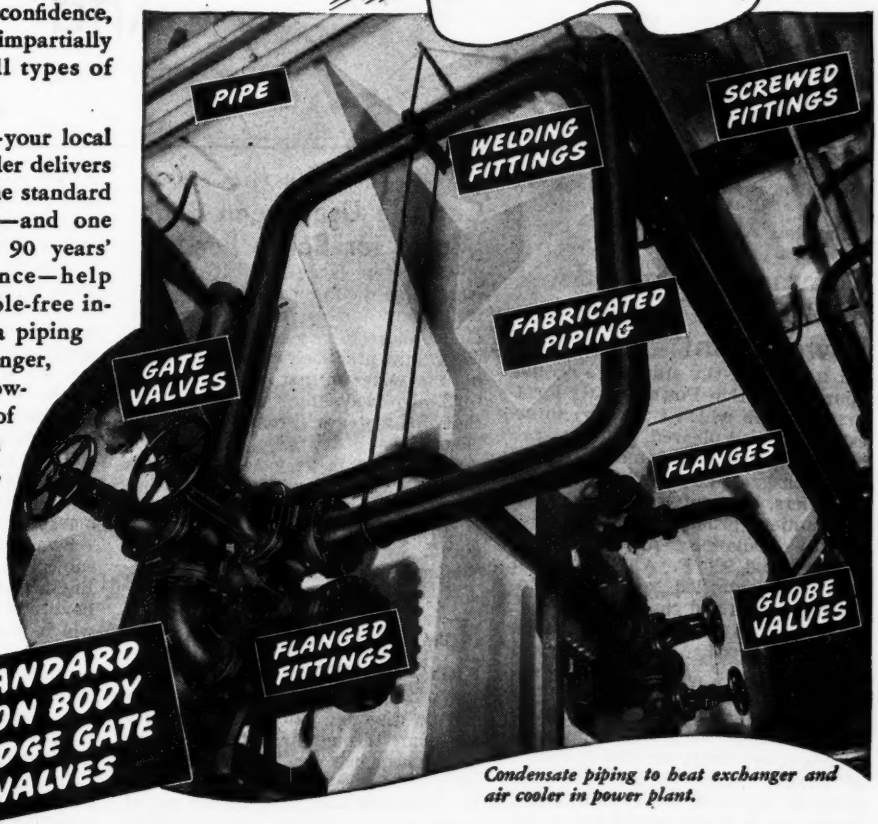
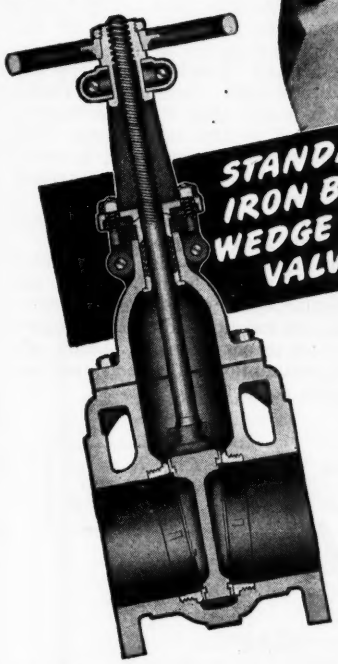


Condensate piping to heat exchanger and air cooler in power plant.



SERVICE RECOMMENDATIONS: **Crane Standard Iron Body Wedge Gate Valves** are suited for many services in factories and power plants, at all working pressures up to 125 pounds steam. Brass trimmed valves are recommended for steam, water or oil lines; all-iron valves for oil, gas or fluids that corrode brass but not iron. Made in O.S. & Y. and Non-Rising Stem patterns. See page 101 of your Crane Catalog.

WORKING PRESSURES

Size of Valve	Screwed or Flanged End Valves		Hub End Valves
	Saturated Steam	Cold Water, Oil or Gas, Non-Shock	Cold Water or Gas Non-Shock
2 to 12 in.	125 pounds	200 pounds	200 pounds
14 and 16 in.	125 pounds	150 pounds	150 pounds
18 to 24 in.	*	150 pounds	150 pounds

*For steam lines larger than 16-in., Crane 150-Pound Cast Steel Gate Valves are recommended. (For sizes under 2-in., use Crane Clamp Gate Valves.)

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PLUMBING • HEATING • PUMPS

of the Boiler Inspector Department as such.

That those, who are qualified to know, and pass an opinion, are satisfied with present conditions, and how the Act is applied, is open to serious question. It is also open to serious doubt, that a department may investigate itself, revise, or amend, or change laws, within itself. The time is long overdue for an independent board or commission to be appointed to investigate the whole situation, and make recommendations that will be clear and definite, as to the Boilers Act and its provisions, and remove political expediency, or the suggestion of it out of the picture. Furthermore, such a board could well be permanent, and function from time to time, in the matter of revisions and amendments, which up to the present time has been a hit or miss affair, carried out from the inside to suit conveniences, and individual tastes.

WM. S. WHITE.

Ponaka, Alta.
Canada.

Comments Wanted on 1500-psi English Power Plant

I HAVE RECENTLY started to receive your publication POWER PLANT ENGINEERING with which I am very interested and well pleased.

I am in charge of a modern boiler plant consisting of five 150,000-lb-per-hr boilers. Two of these operate on the Cantieny principle and three have forced circulation. All operate at 1500 psi and 960 F. All have Ward Leonard controlled auxiliaries including pumps and chain grates.

This is one of the very few high pressure plants here in England, and the plant itself raises many controversial points, e.g. forced and natural circulation. I would like to get in touch with any interested American engineers who are in charge of similar high-pressure plants in order to compare notes about many points which I feel would be to our mutual benefit, and probably suitable for an article in your paper concerning American and British practices.

A point I would like to raise separately from the above is as follows:

In the boiler plant of which I am in charge, I have four 7 cylinder ram feed pumps for a discharge pressure of 1700 psi and a capacity of 165,000 lb per hr. These are driven by a d-c motor with Ward Leonard speed control.

As emergency plant I have 2 similar capacity steam turbine driven centrifugal pumps whose exhaust steam passes to the main turbine condensers.

The question I would like to discuss is the relative merits of the two types of pump for the work in hand. Very little extra-high pressure plant is installed here in comparison with the USA and I would like to hear opinions on the matter.

The chief troubles I have found with the ram pumps are failure of glands and complete unsuitability to the employment of automatic feed control. A controller to operate the Ward Leonard controller for the pump would be unsuitable, as other auxiliaries would be affected, since all are supplied from the same Ward Leonard generator in order to obtain complete unified control of all boiler auxiliaries.

E. Emerson, Combustion Engineer
March, Cambs, England

Questions And Answers

Question No. 314

Can He Use Green Bean Water for Boiler Feed?

WE USE a large quantity of hot water in the processing of green beans for canning. During the processing the water is contaminated. Is there any practical means of cleaning this water so that it could be used for boiler feedwater? It is my belief that this water will foam unless it is cleaned.

Our water is very soft and does not scale the boiler. If we could use this processing water for the boiler, our fuel bill would be greatly reduced.

Siloam Springs, Ark. R. M. S.

Question No. 315

How Calculate Steam Flow Through Slots?

WHAT FORMULAS and co-efficients can be used for calculating the flow of steam through the V slot shown on the attached sketch? Steam at 75 psi gage flows vertically up through the standard 1-in. pipe, on the top of which is screwed a special cubical fitting (something like a cubical pipe elbow) in the end of which are machined two slots, forming a V, of the dimensions shown.

The steam, issuing from these slots into the atmosphere, mixes with a certain industrial material and the steam jet then blows the mixture into a second device whose capacity must be calculated. We can measure the amount of the industrial material satisfactorily, but in order to determine the capacity of the second device to handle the mixture of this material and the condensed steam, we must be able to measure the steam with reasonable accuracy.

For various reasons, there is no practicable method of installing a flow meter on the 1-in. pipe line to measure the flow in it.

Searching for information on this subject, we found in the magazine Engineering (London), a paper on flow through rectangular orifies, which states that Napier's formula was used in the calculations. This formula is $W = pa \div 70$, in which W equals the rate of flow in pounds per second, p equals pressure in pounds per square inch absolute, and a equals area in square inches.

In hydraulic and hydroelectric practice, flow of water through rectangular openings—sluice gate openings, for example—can be calculated for various conditions by making certain assumptions of velocity and approach coefficients.

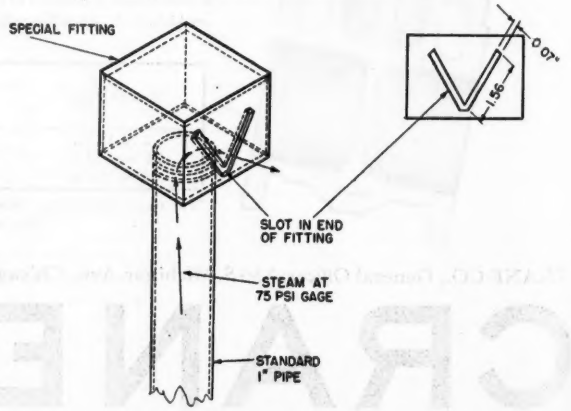
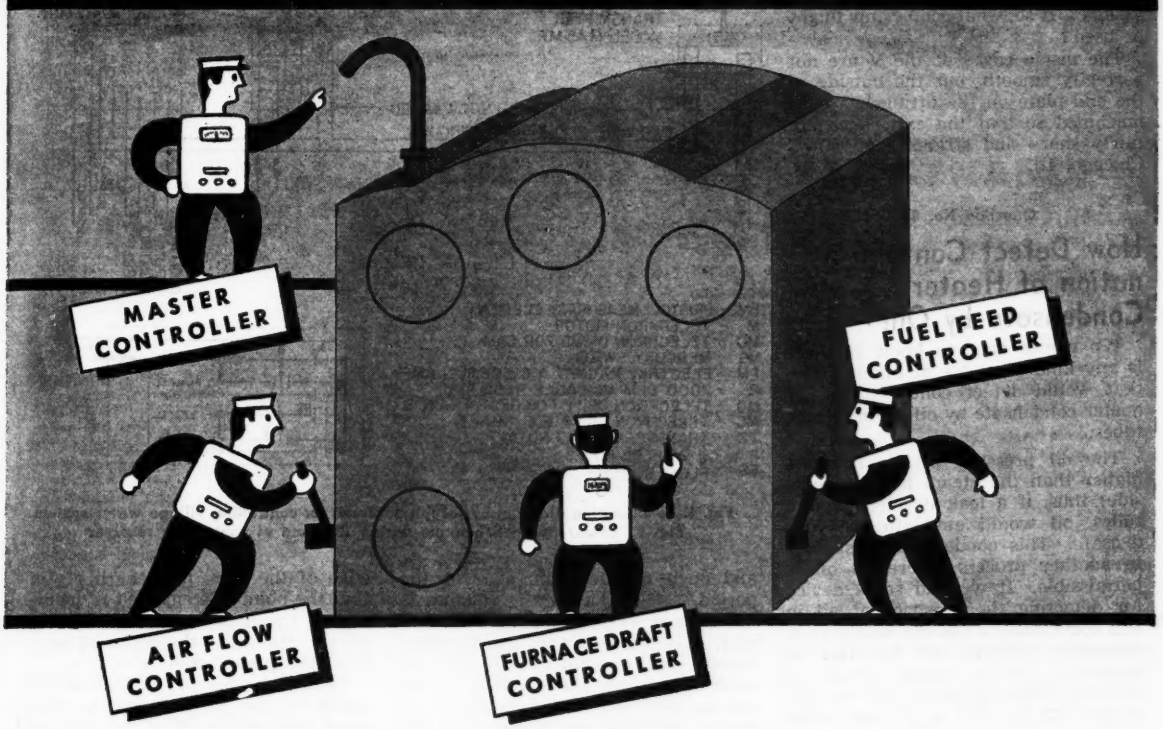


Diagram by J. R. D. showing construction of special fitting with V slot through which steam flow is to be calculated. long and 0.07 in. Each slot is 1.56 in. wide

ELECTRICAL OPERATION IS AS MODERN AS POST WAR INDUSTRY MUST BE!



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5. Elements of a good controller.
6. *Coordinating* the controllers.
7. Selecting the best system for your needs.
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9. How each individual controller operates.
10. How controllers are calibrated and adjusted to fit requirements.
11. How controllers are stabilized to prevent hunting or over-travel.
12. Typical installations of Automatic Combustion Control.

IT'S LIKE HAVING a smart, tireless four-man crew on the job—the boss (Master Pressure Controller) who waits for the call from the plant for more steam, then calls on the others to give him the necessary cooperation; the two men who control the Air (Air Flow Controller) and Fuel (Fuel Feed Controller) respectively; and the man who keeps the furnace draft constant (Furnace Draft Controller).

To a central panel come reports of every fluctuation in every combustion factor, to be recorded and measured. Instantly accurate impulses go from the Master Controller to the Air and Fuel Controllers. These subordinate controls in turn transmit their impulses instantaneously to the damper or air control device and to the fuel feed device. Thus steam generation is ***kept in practically perfect balance constantly.***

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MICHIGAN CITY, INDIANA, U.S.A.

Are any of the above methods, with proper coefficients, satisfactory for calculating the flow through these V slots? If so, what coefficients might be used?

The inside edges of the V are not perfectly smooth, but the outside of the end plate on the fitting has been machined so that the exit edges are fairly sharp and straight.

Chicago, Ill. J. R. D.

Question No. 316

How Detect Contamination of Heater Condensate by Oil?

WE WOULD LIKE to know if there is any kind of meter or other device that would detect contamination of heater condensate by oil in the heater tubes.

The oil pressure in the tubes is higher than the steam pressure outside; thus, if a leak develops in the tubes, oil would get into the condensate. This condensate must flow to another process where no oil is permissible. If we had some device for detecting the presence of oil in this condensate while the heater is in operation, perhaps the detecting or measuring device could actuate a warning signal or could even be used to shut off the flow of oil and steam to the heater.

We understand, of course, that an oil filter or oil extractor could be installed to remove oil from the condensate before it flows to the next process, but knowledge of conditions in the heater at all times would help us greatly in operating the entire system.

Toledo, Ohio E. H. R.

Answer No. 305

How Control Village Water System from Pressure?

Telemetering System for Controlling Water System

I SHALL only propose to offer a solution to Mr. F. J. H.'s problem of maintaining an automatic control of high and low water levels in the reservoir, and to protect pumps in case of low water in wells.

The layout as shown in Fig. 1 is very simple and consists of only four main parts; namely, transmitter, transmission circuits (telephone circuit), receiving recorder, and controlling receiver. The principle of this operation is of a time impulse nature. The following explains the complete cycle of operation.

The measured values of the quantity-water level (pressure) are transmitted from the transmitter as a function of time in the form of successive impulses of current in the transmitting circuit. During each 15-sec period, the mercury switch MS is closed for part of the period and open for the remainder of the period. The value of the reading is determined by the length of time in each 15-sec period that the mercury switch shall remain closed. This in turn determines the position of the pen on the chart in the recording receiver and also the position of the pointer as determined by the controlling element in the controlling receiver.

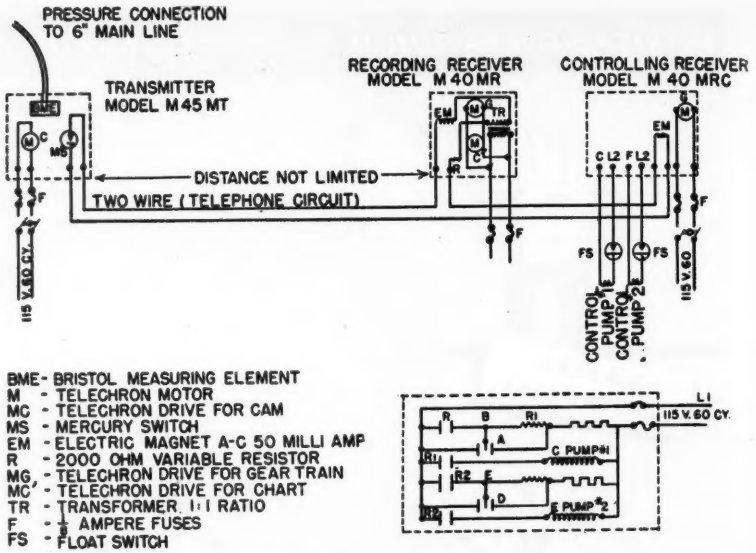
PRESSURE CONNECTION TO 6" MAIN LINE
TRANSMITTER MODEL M 45 MT
RECORDING RECEIVER MODEL M 40 MR
CONTROLLING RECEIVER MODEL M 40 MRC
DISTANCE NOT LIMITED
TWO WIRE (TELEPHONE CIRCUIT)
115 V. 60 CY.
CONTROL PUMP 1
CONTROL PUMP 2
BME- BRISTOL MEASURING ELEMENT
M - TELECHRON MOTOR
MC - TELECHRON DRIVE FOR CAM
MS - MERCURY SWITCH
EM - ELECTRIC MAGNET A-C 50 MILLI AMP
R - 2000 OHM VARIABLE RESISTOR
MG - TELECHRON DRIVE FOR GEAR TRAIN
MC' - TELECHRON DRIVE FOR CHART
TR - TRANSFORMER 1:1 RATIO
F - AMPERE FUSES
FS - FLOAT SWITCH
L1
115 V. 60 CY.
C PUMP#1
F PUMP#2

Fig. 1. Telemetering diagram by Joseph Sullivant for controlling village water system
Fig. 2. Lower right—Schematic wiring diagram of controlling receiver

Since values are transmitted to the receiver as a function of time, electrical energy is only required to furnish power for the electrical impulses set up in the transmitting circuit and to operate the Telechron motors which drive the gear train and mechanisms in the transmitter and receiver. Therefore, the accuracy of the "metameter" is not affected by the transmitting circuit. Large variations in voltage current and line resistance do not affect the accuracy of operation.

The transmitter should be installed in a concrete pit at the foot of the reservoir over the water main, so as to permit the pressure connection to the water main. Transmitter should be equipped with a Bristol pressure measuring element B.M.E. Fig. 1, for a 24-ft head to measure the quantity. Transmitting mechanism consists of a rotating spiral cam, rocker plate, and a magnet type mercury switch. The pointer of the measuring element swings between the rocker plate and the cam in such a manner that when the cam engages the end of the pointer, the rocker plate is moved forward through a limited travel, thereby actuating the magnet switch.

The cam is rotated continuously at a constant speed of one revolution every 15-sec by a Telechron motor and always engages the pointer at the same instant during each cycle. But, due to the shape of the trailing edge of the cam, the length of time that the pointer is engaged is dependent on the deflection of the pointer, which represents the value of water level being measured.

Since the mercury switch is actuated by the magnet and is closed when the rider is off of the cam, and since the cam rotates at a constant speed of one revolution in 15 sec, then the time the rider is on and off the cam is always 15 sec for each cycle regardless of the pointer position. The time the rider is off the cam each cycle changes as the pointer and rider are moved along the edge of the rocker plate by the measuring element. This governs the duration of each impulse transmitted to the receiver, therefore making it proportional to the measured quantity.

The transmitting circuit, about 4800 ft long, requires only a simple two-wire circuit, since the current which it must carry is very small, approximately 50 milli-amp. Any two-wire open telephone lead is ideal for this application. However, if such a circuit is available and is the property of the operating telephone company, then this telephone company may require you to install isolating transformers, isolating switches and fuses, condensers, and arrestors which will be governed by its own requirements and certain War Department requirements.

The receiver, as the name signifies, receives and records the readings. The receiver consists of a pen which is positioned on the chart in accordance with the deflection of the pointer in the transmitter. An individual Telechron drive is furnished to rotate the chart one revolution each twenty-four hour period.

The electro-magnet receives its impulses from the transmitter and operates in accordance with the time

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MEANS THE RIGHT VALVE FOR LONG LIFE AND EASY MAINTENANCE

FOSTER REGULATION ENGINEERING applies to valves of all types and capacities. Here's a small one, Type 39-Y3 for close regulation of small volumes of steam, air, water or oils. It is one of several Foster Y-types.

OPERATING FEATURES

Easier action because of exceptionally long, large diameter spring.

Pressure equalizes faster because the snubbing action of finger-type springs prevents overtravel of the disc.

Full effective area of the diaphragm is maintained through use of properly proportioned jamb nut.

Only small changes in reduced pressure are needed to overcome inlet pressure at orifice. Ratio of diaphragm area to orifice area is 150 to 1.

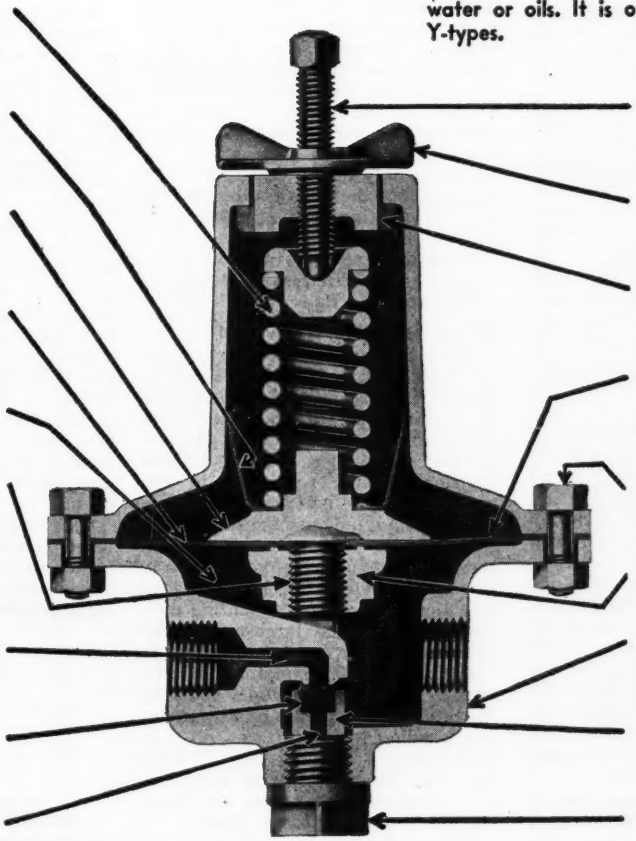
Regulation is closer because large chamber permits complete expansion.

High diaphragm pressures do not affect thread structure or joint tightness because of large diameter, rigid load screw.

Full satisfaction of downstream demand up to the capacity of the valve is obtained because of large area, smooth entrance port, assuring full inlet pressure at orifice seat.

Grit particles are absorbed by soft disc preventing damage to seat.

Disc always returns to same seating indenture because of guide pin.



MAINTENANCE FEATURES

Close adjustment of reduced pressure is easy because adjusting spring is long, with fine thread.

Once set, locknut assures constant compression of spring, regardless of line vibration.

Quick inspection or spring replacement because of removable bayonet-type head.

Diaphragm assembly with jamb nuts, yoke and disc can be removed as a unit for inspection without breaking center joint.

Quick dismantling at main joint because of easily replaced, standard bolts and nuts.

Diaphragm can be readily inspected or replaced. Yoke unscrews at center thread.

Sediment and scale can be removed without special tools because of open type body.

Hole provided in yoke makes it easy to drive out worn disc.

Seat may be inspected or resurfaced through bottom plug opening.

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(2) Thorough knowledge of performance characteristics necessary for selection of the right valve for the application.

(3) Sixty-six year's experience in design and manufacture of practical valves.

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cycle as established by the transmitter. The cycle consists of an energized period and a de-energized period, the duration of each is proportional to the measured quantity. The electro-magnet receiving impulses from the transmitter control the operation of the recording element in moving the pen according to the duration of the impulses and intervals between them to record the value of the quantity water level measured.

Certain model receivers are equipped with alarm contacts for signaling to give notice that certain limits have been reached. The contacts are adjustable and can be set to operate at any predetermined point on the scale.

The controlling receiver is sometimes called a sequence pump controlling receiver and consists of an electro-magnet connected in series with the electro-magnet in the recording receiver; therefore, each electro-magnet must receive the same amount of current and also the same impulses as transmitted by the transmitter.

The operating cycle of the controlling receiver is the same as that of the recording receiver. The only appreciable difference is that in the mechanical linkage and gear train used for the sequence of pump control.

Figure 2 shows schematic wiring of control circuits with two high and two low switch contacts and two relays. The contacts are adjustable and can be set to cut in or cut out each circuit as desired. For example, if you wish to maintain a high level of 23 ft and a low level of 21 ft, then set No. 1 pump circuit to cut in at 22-ft level and cut out at 23 ft, the high maximum level; set No. 2 pump circuit to cut in at 21-ft level and cut out at 23 ft; or if No. 1 circuit is the better well, then cut No. 2 circuit out at 22 ft. Any combination of settings for automatic control of pumps may be obtained by this controller.

In Fig. 1 I have indicated a Float Switch F.S. connected in series with the pump control circuit. A float may be installed in each well with a rod ⅜ in. in diameter with the necessary stops and linkage which will be actuated when the high and low limits of the water in the well have been reached.

This method of automatic recording and controlling has been in use for quite a number of years, and has been approved by good engineering practices. JOSEPH E. SULLIVANT.
Salina, Kan.

Answer No. 306

Are Gaskets and Packing Supplies or Maintenance?

They're Maintenance, Says Mullen

THIS IS A good question and I feel that many other engineers will like to see the answer on this question.

I agree with the first school of thought; that is, these (packing and gaskets) are maintenance because they are part of the machinery and any part that wears out must be replaced to successfully operate the machinery.

Another point to be considered is that when the packing is gone or a gasket is to be renewed, it is marked in the log-book so as to determine if the item is giving the proper service that is expected from it. Lamps, paint, hose or brushes aren't logged and I believe this is one point in favor of classifying between these two schools of thought. Only at certain times are the stores gone over so as to replenish these stores, for instance quarterly, to maintain cleanliness and sufficient light at all times. As for feed-water treatment, it could be classed as protection as well as the fore-runner of boiler cleanliness.

This is only how I feel about the question, but the answers to this will make interesting reading matter. I'll be watching for other comments.

From one engineer to another,
WILLIAM T. MULLEN
Philadelphia, Pa.

All Charged to "Supplies on Hand"

THIS IS A subject on which there is no uniformity of opinion. The subject is at present under discussion by a committee of engineers from several of the Pacific Coast gas and electric companies, but a definite decision is still sometime in the future. However, at one of the refresher and advancement courses given locally for power plant engineers, one evening was given over to accounting systems for power plants, with the head of the accounting division of one of the largest Southern California power systems as speaker.

The system, as explained by this speaker, was to carry all costs of operation and maintenance under one heading, as there was no way of drawing a dividing line between the two. All materials in the plant were charged under two headings: Capital and Supplies on Hand.

Under Capital was charged the plant proper, spare parts and special equipment that could be only used in that one particular plant. A uniform rate of depreciation was charged to everything under the Capital heading, as it would all become obsolete or worn out at the same time.

Under the heading of Supplies on Hand came all materials that were used up in the operation and maintenance of the plant. This would include valves and pieces of equipment that could be used anywhere on the system. Supplies, as issued, are charged to Operation and Maintenance.

Personally, I prefer this system of accounting, I have never been able to distinguish a dividing line where operation ends and maintenance begins. Therefore, it simplifies the accounting system to use a single heading, and charge all materials used under the sub-headings of Fuel, Lubricants, Supplies, etc.

HOWARD T. LIVINGSTON
Los Angeles, Calif.

Answer No. 309

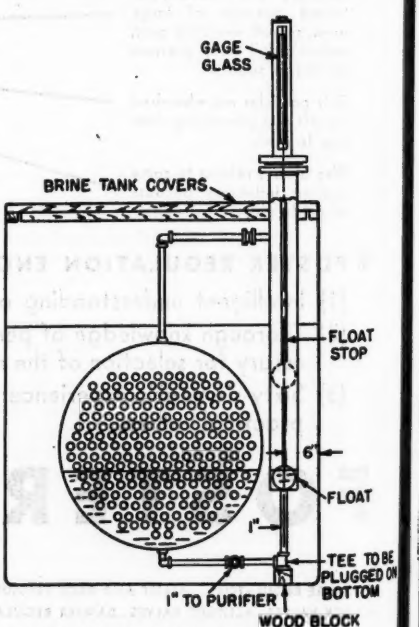
How Does Level Indicator Work on Brine Cooler?

IN THE OCTOBER ISSUE W.M.H. said that the ammonia level indicators on his brine coolers do not work properly and asked for a detailed description of an ammonia level indicator for such coolers.

George Holman gave detailed instructions for making and installing such an indicator. Here is another design of indicator for use on brine coolers that was shown in an article entitled, "Care and Operation of Shell Type Brine Coolers," by Frank M. Bennett, published in the August 15, 1925, issue of POWER PLANT ENGINEERING.

Most brine coolers have for years been equipped with a frost column, said Mr. Bennett, which generally consisted of a piece of 3-in. pipe hooked up in the form of a gage column and connected to the top and bottom of the cooler. The height of the frost line on the pipe gave an indication of the height of the liquid in the shell cooler. However, says Mr. Bennett, there has been developed a positive-flow type gage column, as shown in the accompanying sketch.

This column is connected to the brine cooler at top and bottom as shown so that the liquid level in the gage column is the same as in the shell cooler itself. A float floats in



Ammonia level indicator for brine cooler described by Frank M. Bennett

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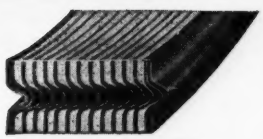
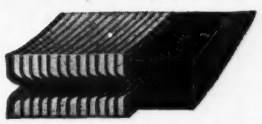


AJAX Spiral Wound

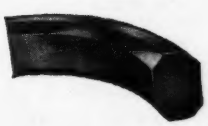


AJAX S-R Spiral-Wound

Oval Solid Metal Ring Type

Single Jacket Metal-Asbestos

Double Jacket Metal-Asbestos



Octagonal Solid Metal Ring Type

the liquid in the gage column and by means of a piece of drill rod carries a cork indicator up into the gage glass extending above the top of the column. There is no circulation of ammonia through the gage glass, consequently no frost prevents observation of the indicator. Thus the operator has a positive indication of the level of the liquid in the cooler.

At first glance, said Mr. Bennett, the average engineer might object to the construction of this gage column because of the possibility of ammonia loss in case the gage glass is accidentally broken. However, these gage columns are constructed, he says, by using a perfectly straight steel drill rod to carry the indicator cork. This drill rod passes through an orifice that separates the gage column from the gage glass, the orifice being only a few thousandths of an inch larger in diameter than the drill rod. Consequently if the glass breaks there is only a small area for ammonia to escape through and the ammonia loss is so slight that a new gage glass can be put in without the use of a gas mask.

In view of the tremendous progress that has been made in the construction of gage glasses, and the development of glass for use at extremely high pressures since Mr. Bennett's article was written, it would seem that there should be little difficulty in securing a gage glass for this indicator that could not be easily broken by any of the routine operations. Of course, if the gage glass stuck up through the cover of the brine tank as shown, in such a way as to be exposed to swinging crane hooks or passing trucks, or anything of that sort, it could be damaged.

It might be possible to use a closed column instead of the gage glass and to wind this column with a coil of wire in such a way that the steel rod, raised and lowered by the float as the level varies, would vary the inductance in the coil of wire to actuate an electrical type of indicator. There are also commercial level indicating and recording devices — bellows actuated indicators, differential transmitters, impedance coil indicators, indicators using manometers, etc. — that could measure this level.

Answer No. 307

Wanted: Design for Electrical Test Panel

Avant Uses Just the Panel E. J. B. Needs; Tells How It's Made

THE PRACTICAL Engineer and Electrician section of POWER PLANT ENGINEERING alone is worth many times the price of the subscription to me. I never go through the yellow pages without finding some item that will help me to be a better maintenance electrician. I also want to help any of my fellow readers that I can. This question by E. J. B. appeals to me because I have to use just such a set-up as he indicates he would need.

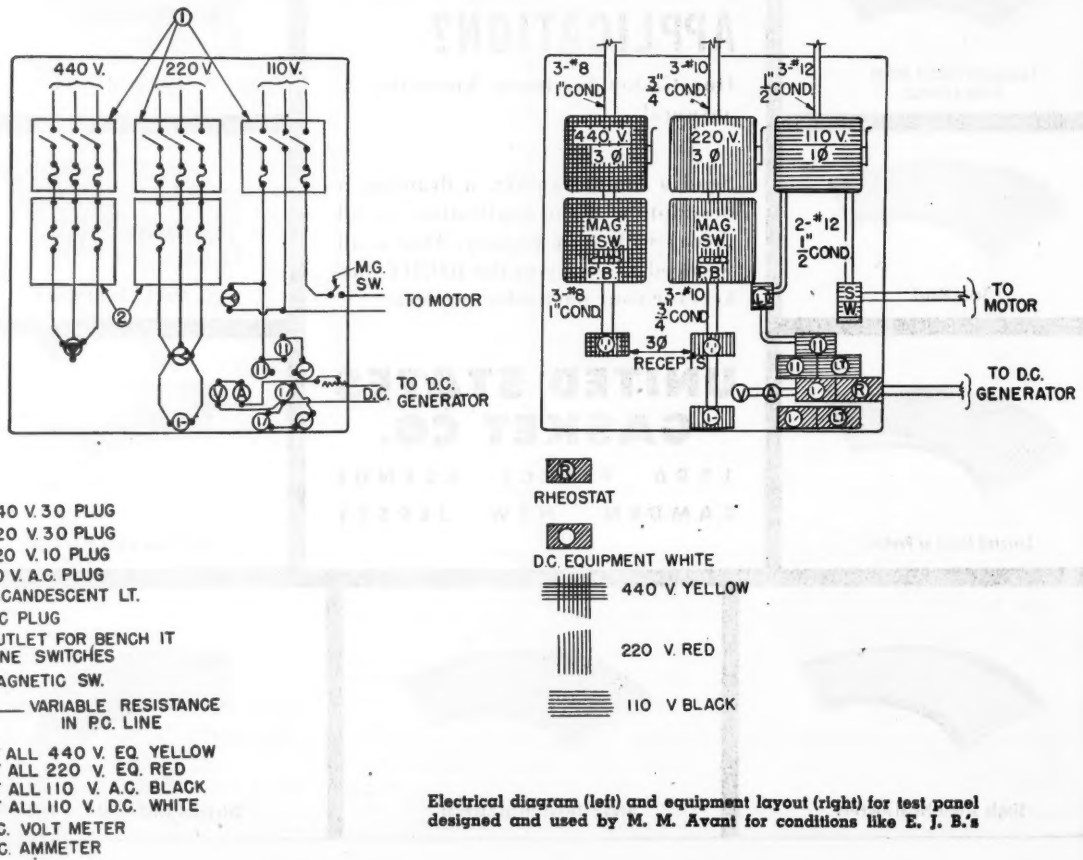
Here is a sketch of my test panel, slightly modified (because I'm no draftsman) but complete enough for everyday trouble-shooting and bench work.

I believe everything on the sketch is self explanatory, but let me elaborate just a bit. The two lights in series with the 110-v a-c and d-c plug-ins are for protection of equipment being tested, also for lighting the panel, and for checking opens, shorts, and grounds. Motor-generator set and rheostat are especially adapted to coil testing, along with growler, feeler, etc.

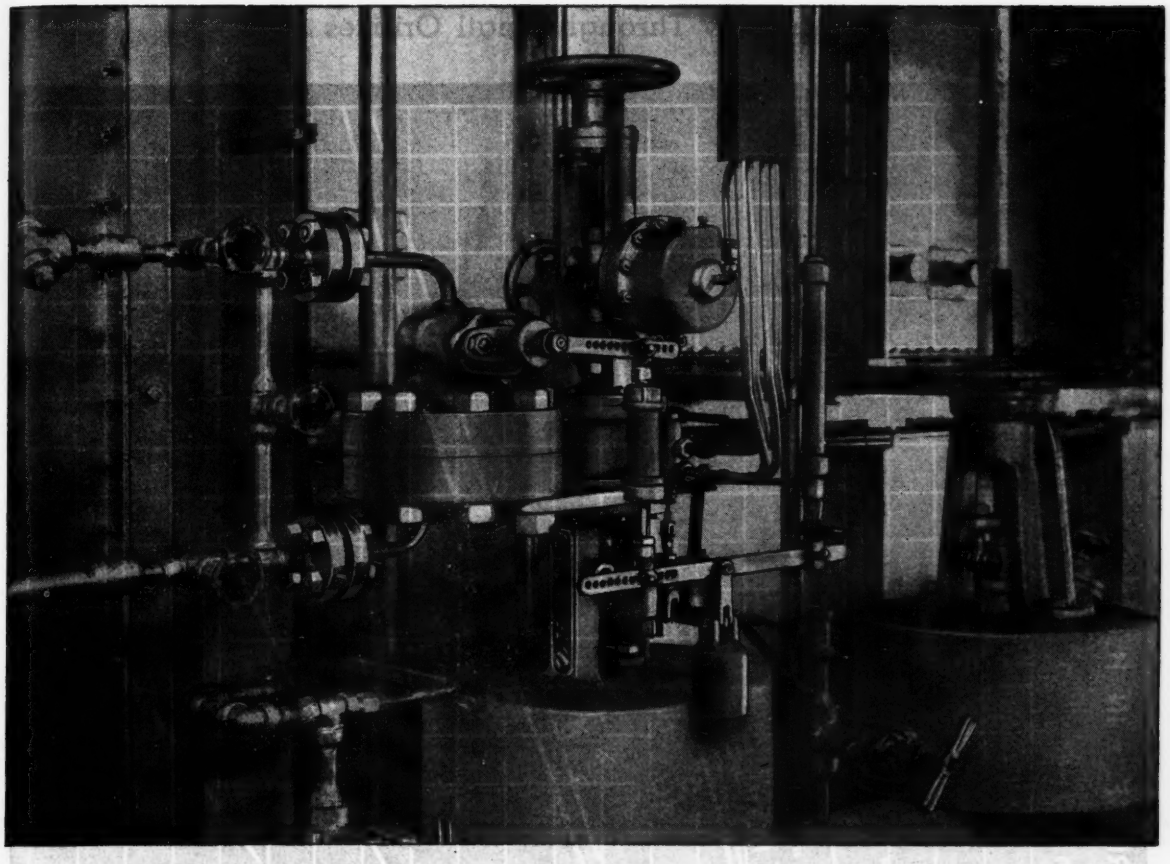
A few additional essentials are: a-c volt and ammeters; plug-in test leads about 5 ft long, one for each type plug; grounded metal-top bench with at least a 6-in. overhang for securing work thereto; machinist's and pipe vise; a good electric soldering iron, or better still, an Ideal thermo-grip set; an electric drill; a variety of insulating materials, (sheet and tube); a speed indicator; air-gap feeler gages, etc.

I would like to see some of the other fellow's ideas for my own benefit.

Houston, Texas — M. M. AVANT



Electrical diagram (left) and equipment layout (right) for test panel designed and used by M. M. Avant for conditions like E. J. B.'s



For 500,000 pounds per hour and 975 psi. . .

This is one of two 5-inch relay-operated COPES Flowmatics controlling water level on a C-E boiler designed for 500,000 pounds per hour and 975 psi. and installed in a mid-western utility plant. A second C-E unit and a 400,000-pounds-per-hour Riley generator have similar COPES Flowmatic equipment.

Users say the simplified two-element Flowmatic, responsive to steam flow and water level changes, is just about as easy to adjust and operate as a simple level control. It gives them more time to coordinate other auxiliaries and controls for the peak efficiencies demanded by high-duty boilers.

Want to know how the COPES Flowmatic operates —who uses it—what results they get? Write for Bulletin 429-A—your letterhead, please.

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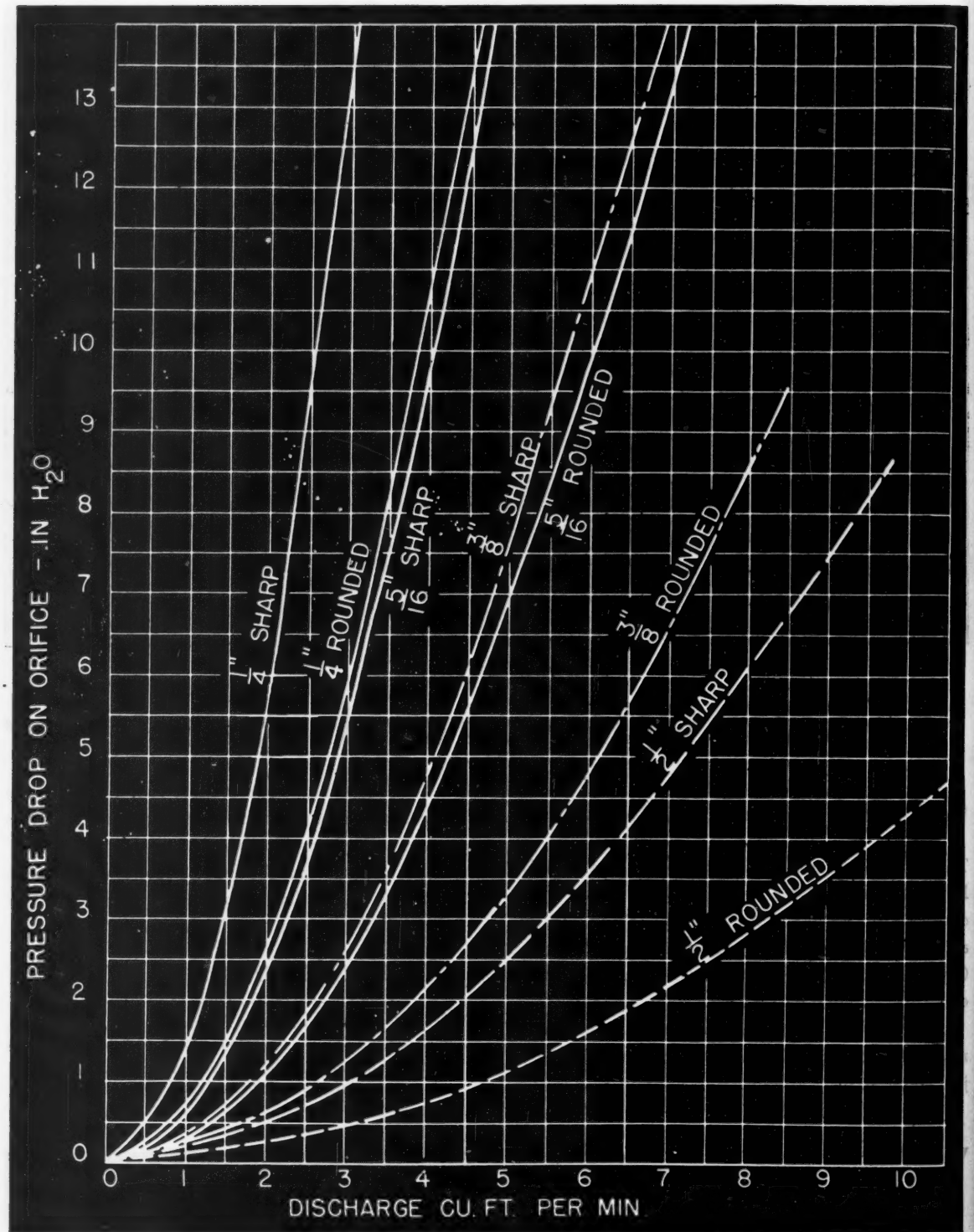
Air Flow Through Small Orifices



This chart, by Bill Maddock, was developed for reading the air discharge from condenser jet evactors with the air discharged to the atmosphere. It is based on the formula $Q = A \times C \times 4000\sqrt{h}$ where A = Sq ft orifice; h = in. H_2O pressure drop; C = 0.6 for sharp edges or 0.9 for rounded edges.

BEARING DOWN ON BEARING TROUBLE

SOLNUS OIL . . .

Lowers Bearing-Temperature on Generator, Ends Oil-Throw, Averts Costly Shutdown

While ring-oiled bearings are usually considered a routine matter, here is a case from the Sun industrial files that demonstrates the need for the right oil in the right place — even in simple applications.

An eastern manufacturer called in the local Sun Engineer to study the bearings of the main generator in his power-plant. Bearing-temperatures were high, and the lubricant was being thrown off onto the generator-coils.

Serious injury to the generator — which would have forced a shutdown of the whole plant for an indefinite period — was avoided when they switched to the Solnus Oil recommended by the Sun Engineer.

Bearing-temperatures dropped, and throw-off of oil was reduced to a minimum. The company now uses Solnus Oil for all ring-oiled, electric motors.

In plant after plant, Sun Engineers and Sun lubricants have helped to avoid shutdowns, to increase net production, and to cut maintenance-costs. For all types of power-equipment, Sun manufactures a complete line of quality lubricants . . . for generators; motors; turbines; Diesels; and other types of internal combustion engines. Call the local Sun Engineer near you — or write direct to . . .

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Relief Valve Application

Selection and location of diaphragm type atmospheric relief valve for turbo-generators—Directions for calculating steam pressure drop—Choice of valve size assisted by use of chart

By M. C. RANDALL

Senior Engineer, Mechanical Division, Philadelphia, Pa.

IN AN article published in the September, 1945, issue of POWER PLANT ENGINEERING on page 94, a general description of a new atmospheric relief valve for turbo-generators was discussed. To aid designing engineers in the proper selection and location of this valve, the following material has been prepared as the result of several years use of the valve by Philadelphia Electric Co. in its Chester generating plant.

This valve provides a perfect vacuum seal maintained through the use of a diaphragm which is mechanically sheared when a positive pressure of relatively low magnitude develops. The diaphragm removal is accomplished by means of a pair of pivoted swinging gates to which the diaphragm is attached, so that when the valve operates, a clear escape passage is developed. The design as evolved requires no valve stem, packing gland, bonnet or hand wheel, or access platforms; the entire valve assembly being little more than a welded flanged spool piece in the line. Thus space and weight requirements are reduced to a minimum.

Selection and Location

The proper selection of an atmospheric relief valve should be based on the following information:

A. Total steam admission at the turbine throttle in pounds of steam per hour.

B. Steam conditions and quantity at the turbine exhaust end.

C. Maximum allowable turbine exhaust end pressure.

The above information will be furnished by the turbine manufacturer; the number and size of the condenser relief openings will be given by the condenser manufacturer.

The designing engineers may use the condenser relief opening as an index to the size and number of relief valve required, when the physical arrangement of the relief line or lines has been determined.

When possible the atmospheric valve should be located as close to the condenser as possible. This practice will permit miscellaneous relief connections to be made to the main relief lines on the atmospheric side of the relief valve.

Friction Loss

The turbine manufacturer will furnish all the information with respect to Items A to C inclusive, but he cannot tell the designing engineer the path the turbine relief lines will follow. This is dictated by the physical arrangement of equipment and its associated piping. Therefore, the friction drop in the turbine relief line from the condenser outlet to the free exhaust stack exit must be calculated. This determination may show that while the condenser manufacturer may have provided openings sufficiently large to meet relief requirements, the relief lines may follow a path that would create a friction loss resulting in back pressure in excess of that permissible by the turbine manufacturer. It therefore follows that a larger relief line must be provided, wherein the total friction loss and relief valve loss are reasonably below the allowance maximum by the manufacturer. A safe practice is to limit the total valve and friction loss in the relief system to result in a back pressure of one-half the allowable turbine end pressure.

A typical example showing the step by step calculation required in properly selecting an atmospheric relief valve is given below: (For purposes of the example let us assume the manufacturer has stated that there will be 400,000 lb of steam per hr, saturated, flowing to the condenser at the time the relief valve is called upon to operate. The permissible back pressure at the turbine exhaust end is 7 psi gage. The condenser manufacturer has stated that a single 30-in. opening is all that his equipment will accommodate. By referring to Fig. 1, it will be noted that the main relief line has been installed to accommodate a future unit and that some 50,000 lb per hr of miscellaneous relief capacity is required in addition to the turbine requirements. The valve shown is a 30 in. inlet and 30 in. outlet. Where necessary the outlet conic section can be varied in diameter to serve as an increaser rather than using an extra fitting, saving space, weight and cost. Good design calls for an expansion joint immediately following the relief valve.

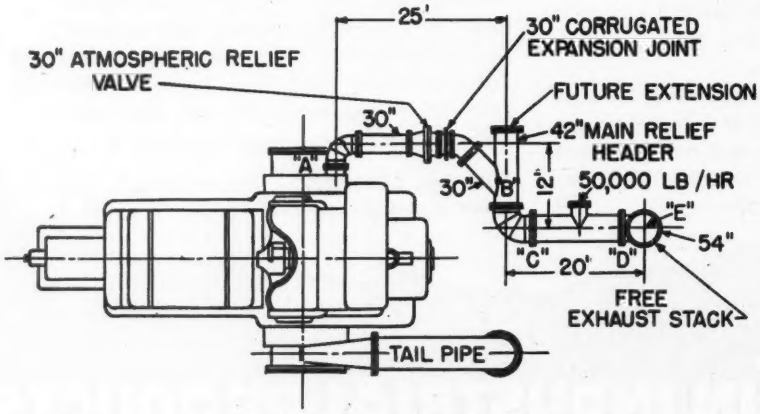

Fig. 1. Typical atmospheric relief valve installation employing a single valve

Table I. Constants for Pressure Drop Formula

Pipe Size, In	Internal Diameter, In	Constant K
14 O.D.	13.5	102.8 x 10^{-12}
16 O.D.	15.5	50.12 x 10^{-12}
18 O.D.	17.5	26.73 x 10^{-12}
20 O.D.	19.5	15.29 x 10^{-12}
24 O.D.	23.5	5.855 x 10^{-12}
30 O.D.	29.376	1.867 x 10^{-12}
36 O.D.	35.00	.7641 x 10^{-12}
42 O.D.	41.00	.3417 x 10^{-12}
48 I.D.	48.00	.1535 x 10^{-12}
54 I.D.	54.00	.0845 x 10^{-12}

Calculation

To compute the pressure drop in the relief system indicated by Fig. 1, a modified form of the well known Babcock-Wilcox formula is used. Since in a calculation of this type, the final pressure is known and the initial pressure is to be determined, we use

$$P_1 = \sqrt{(KW^2L + P_2^2)}$$

Where:

P_1 and P_2 = the initial and final pressure in pounds per square inch absolute

W = pounds of steam per hr

L = equivalent length of pipe in feet

K = a constant equal to

$$0.000131\left(1 + \frac{3.6}{d} - 2P_2V_2\right) \div 3600\ d^5$$

Where d = internal diameter of pipe in inches

V^2 = specific volume corresponding to P^2

To simplify the task of carrying through the calculation, Table 1 has

PREFABRICATION with Tube-Turn welding fittings can effect important savings. Particularly is this true where piping must fit into tight space—up against a wall or ceiling, into narrow pits under floors, or in a ship, to cite only a few examples. It takes elbow room to tighten bolts and screw flanges, but a prefabricated section can be fitted into tight spots easily—and economically.

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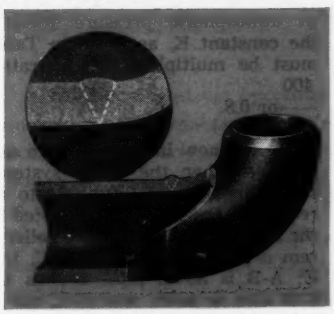


Fused into one piece

See how fitting and pipe are fused into one solid piece of metal, the welded joint actually stronger than the pipe metal itself.

TUBE-TURN TRADE MARK *Welding Fittings and Flanges*

been prepared giving the values of the constant K for pipe sizes from 14 to 54 in. in diameter where PV is equal to 500.

The equivalent lengths of fittings may be taken from a piping handbook or any available data on friction, and value of PV, for each particular case, may be found by referring to the steam tables.

Sequence to Be Followed in Making Calculation

STEP ONE—Determine the value of the product of PV

STEP TWO—Multiply the constant K in Table I by the ratio of $\frac{PV}{500}$ to determine the constant applicable to the pipe size under consideration for the existing steam conditions.

STEP THREE—Determine the equivalent length and flows for each section of the exhaust system.

STEP FOUR—Sum up the products of KW^2L for each pipe section.

STEP FIVE—To the sum of step four add the square of the final absolute pressure which in most cases of this type will be atmospheric. This is the value under the radical sign in the formula.

STEP SIX—Take the square root of step four, substract 14.7 from it. This is the pressure in the turbine exhaust end in pounds per square inch gage, which is the value being sought.

Note: If the pressure indicated in step six is too close to the permissible pressure prescribed by the turbine manufacturer, it will be necessary to enlarge sections of the relief line and recalculate the system.

For purposes of this example, the equivalent length of the relief valve and expansion joint, immediately following it, has been taken as 0.5 of a standard ell each.

Since in the case of saturated steam at atmospheric pressure PV = 400, the constant K, as given in Table I, must be multiplied by the ratio of $\frac{400}{500}$ or 0.8.

We are now in a position to determine whether the relief system as shown in Fig. 1 is adequate to meet requirements. It will be noted that the various portions of the relief system are designed by A, B, C, D and E; A-B is 30-in. pipe, B-C is 42-in. C-D also is 42-in. and D-E, the free exhaust stack has been assumed to be 54 in. inside diameter and 200-ft total length. The necessary data of the problem are given in Table II.

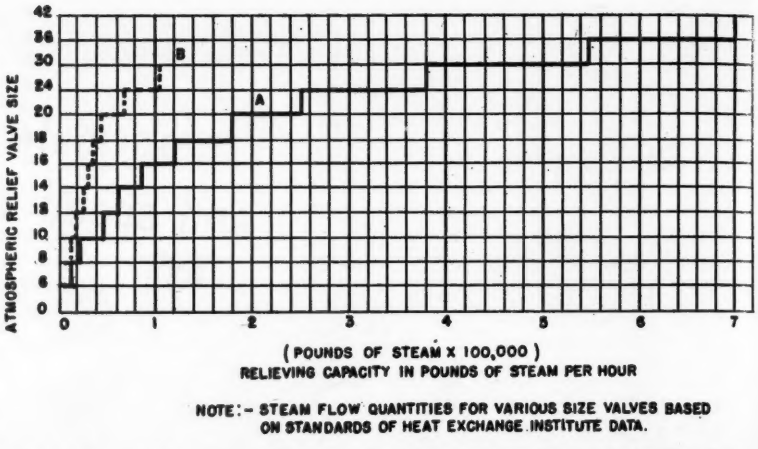


Fig. 2. Valve selection chart. Both graphs are based on throttle flow. Graph A includes allowance for bleed steam. Graph B neglects effect of bleed steam

Assuming atmospheric pressure at top of the stack.

REFER TO STFP FIVE: $P^2 = 216$ Hence $P_1^2 = 216 + 162.4$ or 378.4.

REFER TO STEP SIX: $P_1 = \sqrt{378.4}$ or 19.5. Subtracting 14.7 gives 4.8 psig which is well within the permissible pressure stipulated by the turbine manufacturer.

Where the total steam quantity to be released is in excess of the capacity of a single relief valve, each relief valve should be provided with its individual discharge line. However, this condition is not always possible due to space limitations. If a single exhaust line is dictated, the two individual smaller relief lines should not join the main line at right angles. They should assume the form of a "Y". By this arrangement, the possibility of creating a momentary back pressure on one or the other valves when valve operation takes place will be eliminated. In addition to the protection provided for the exhaust end of the turbine, the condenser and the expansion joint between the turbine and the condenser in smaller type turbines is protected.

Graphs "A" and "B" Fig. 2, indicate the recommended sizes of atmospheric relief valves for normal operation of condensing turbines. The sizes of atmospheric relief valves are somewhat dependent upon their location with respect to the condenser as well as on relief line layout. These curves are based on saturated steam at 5 lb pressure. For the moderate size bleeder type turbine, when the quantity of steam bled is small relative to the total throttle flow, the relieving capacity should be based on throttle rather than on condenser flow. In the case of the large turbines of this type, where the bleed steam may amount to 25-30 per cent of the throttle flow, basing the size of the relief valve on this flow may result in the selection of a valve considerably over capacity. The probability of the turbine going "high" pressure during non-bleeding full load operation is rather remote. For this reason a compromise selection may be justifiable in such a case. It is further suggested that when large quantities of steam are to be relieved, two smaller valves rather than a single large valve may be advantageous. Valve sizes are designated by nominal pipe sizes rather than by diaphragm diameters.

Table II. Data on Relief Valve Problem

Sec.	Pipe Dia. In.	Straight Length in Ft	Equiv. Length of Fittings, Ft	Total Equiv. Length Ft	Flow in Lb Hr	KW^2L
A-B	30	30	320	350	400,000	83.6
B-C	42	16	96	112	800,000	19.6
C-D	42	10	240	250	850,000	49.4
D-E	54	200	...	200	850,000	9.8
						$KW^2L = 162.4$

The Continuous-Flow Conveyor—Correction Note

IN THE FORMULAS for various continuous-flow conveyor paths given at the left of Fig. 12, page 98, November, 1945 issue, the backets got left out of the equation for Paths 5 and 6. This should read as follows:

Paths 5 and 6

$$\text{Motor HP} = \text{TPH} \times [(H \times 0.0032) + (V \times 0.003)] \times 1.2$$

Also, in the formula for Path 8, a plus sign transformed itself into a multiplication sign. This formula should read:

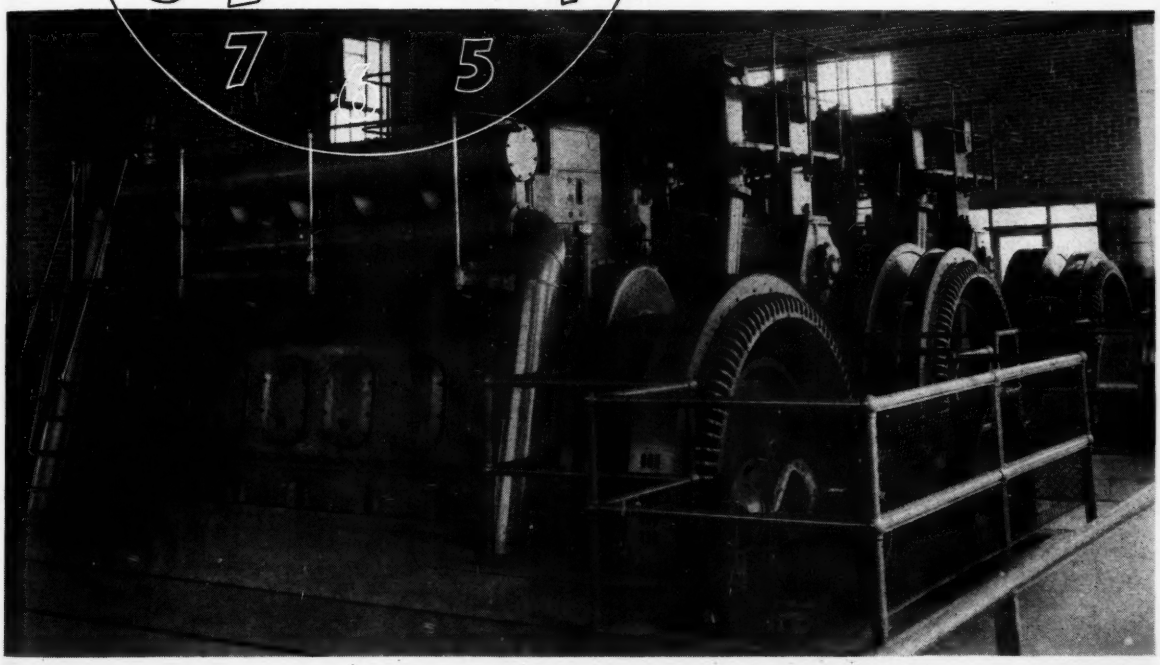
Path 8

$$\text{Motor HP} = \text{TPH} \times [(H \times 0.002) + (V \times 0.003)] \times 1.2$$

Finally, we hope it was apparent to the reader that in Sentence 1, Paragraph 1, Column 1, page 95, we attempted (without much success) to get the French expression "en masse" translated literally into English as "*in* mass" and that the cross-column head near the bottom of Column 2, page 97 should have read "How the Continuous-Fow *Conveyor* is Applied."

BALDWIN PRECISION

helps provide around the clock operation



This Iowa plant is just one example from among many, of how Baldwin Diesel engines serve and save.

The two engines in the background are 400-hp. each, while the new model in the foreground is a 750-hp., 6-cylinder, 16x20 inch, 327 r.p.m. unit. The engineers foresightedly made the building large enough to accommodate an added engine, and the present increase in demand indicates that it will be needed within a few years.

Baldwin focuses every attention on *precision* in the manufacture of its diesels, to assure the dependable operation that is so important in municipal and industrial power plants and the economy that quickly retires the investment. If you have any plant construction or expansion in prospect, ask for full details on Baldwin Diesels.

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BALDWIN

DIESEL ENGINES

Electric Power Practice in Germany

(Continued from page 91)

eration at 400 kv it now develops that these towers must be altered mechanically.

D-c Transmission

There are two schools of thought in Germany regarding the transmission of bulk power over long distances. One group prefers the use of a-c at 400 kv and believe the problems involved have been solved satisfactorily. On the other hand a group in Eastern Germany sponsored by military agencies have been advocating high voltage d-c on the basis of reliability and military security.

Discussion with the Berlin engineers disclose that a trial installation was almost completed when the war ended to transmit power 100 miles at 400 kv, d-c over underground cables. Three mercury-arc rectifiers each having one iron anode were connected in series per phase to produce 200 kv, d-c. A three-wire system was employed having 400 kv from positive to negative and 200 kv from positive or negative to neutral. Only two metallic conductors were used, the neutral being ground itself. Each rectifier was designed for 120 kv and 150 crest amperes. Thus three rectifiers in series for 220 kv, a-c provided a factor of safety of over 50 per cent. Actual test of this installation was never made since the Berlin terminal was destroyed by aerial bombs while the sending end terminal at Elbe Power Station was seized by the Russians and all equipment removed and transported to Russia.

Data was to be obtained from this trial installation to design and project an 800-kv, d-c transmission line from Norway, some 500 miles distant, over cable buried in the ground and laid under sea to utilize potential water power in Norway. Location of potential hydro plants in Norway would be some 600 kilometers or more from the load and since many fiords and the Kattegat would have to be crossed, d-c transmision over cable was considered the only means feasible.

The Belt Conveyor

(Continued from page 93)

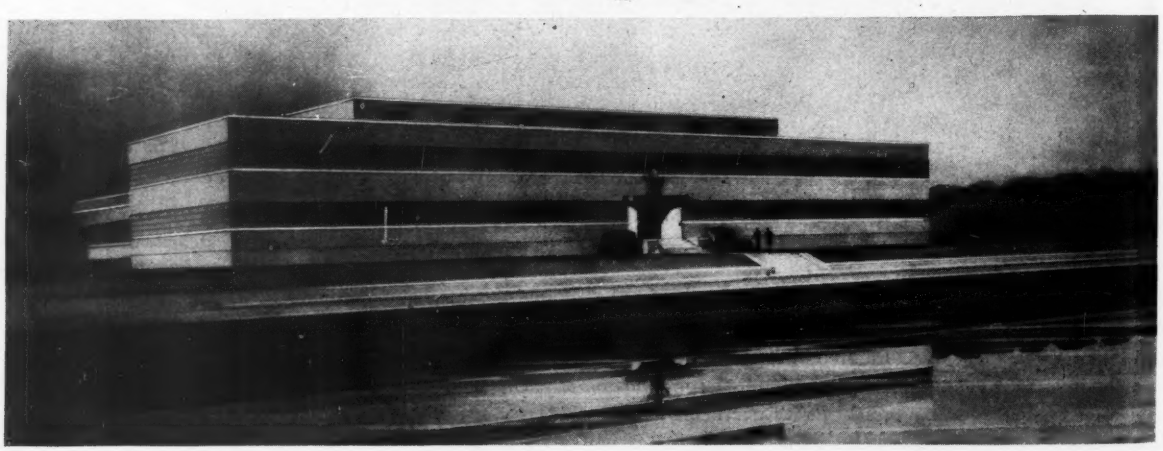
conveyors. The belt must be kept in alignment. This is done readily by shifting a few idlers ahead of the point where the belt starts to run off-center. If necessary, a few of the troughing idlers may be tilted slightly in the direction of belt travel. Cuts and bruises should be repaired just as with an automobile tire.

An effective belt cleaner must be provided. There are several good ones available. The anti-friction roll bearings require very little lubrication for a year or two. Forcing in unnecessary lubricant may damage the delicate seals and force grease out on to the under side of the belt. The passage of the belt through the tripper should be checked occasionally for side rub and for pieces that may lodge between snub pulley and discharge chute. While the modern idler rolls are practically trouble free, they should be examined for cracked shells which might cut the belt.

Maintenance Costs

Maintenance costs in industrial installations are rather difficult to analyze, for the cost records usually lump the costs of the coal-handling equipment without segregating those for the belt conveyor. At one public utility plant with a 30-in. by 300 ft and a tandem 30-in. by 400 ft conveyor with tripper, both on a flat incline, the maintenance cost totaled approximately $400 for eleven years operation, during which 449,000 tons of crushed coal were handled, giving a cost of $0.0009 per ton. The original belts were still in service after eleven years' service and in excellent condition. When 1400 ft of belt is bought, costing about $5.00 per foot, eventually the cost per ton will go to about $0.007 for a tonnage of about 1,000,000 tons.

At another steam plant with a single 30-in. by 300 ft conveyor inclined at 20 deg, and loaded directly from a tramway a feeder between, the records from 1929 to 1936, during which 1,146,000 tons were handled, showed no repairs other than one belt replacement in 1936 at a cost of $2000. This gives a figure of $0.0017 per ton. Gentler loading by a feeder and a flatter slope would improve this figure. At 20 deg there is a tendency for occasional lumps to bounce backward.



Proposed Research Laboratory and Experimental Center

The Allegheny Ludlum Steel Corp. has placed first on its peacetime expansion program the immediate erection of an ultra-modern $2,000,000 research laboratory and experiment center at its headquarters plant, Brackenridge, Pa. With the new facilities, an enlarged and intensified program of fundamental and applied research will be brought to bear on the highly specialized stainless, magnetic, valve, tool, and other complex steels produced by the company. In addition, new and improved fabricating techniques will be developed to bring increased aid to the manufacturers of appliances and equipment used in American homes, businesses and industries. Complete air conditioning, including elimination of dust by electrostatic precipitation, will safeguard delicate scientific instruments and complex experiments. The structure is of steel frame and brick design, with double insulating glass windows. The main two-story-and-penthouse building is extended by a one-story furnace section, containing melting and make-up floors, annealing and melting furnaces, and pickling equipment, for experimental work in steel production.

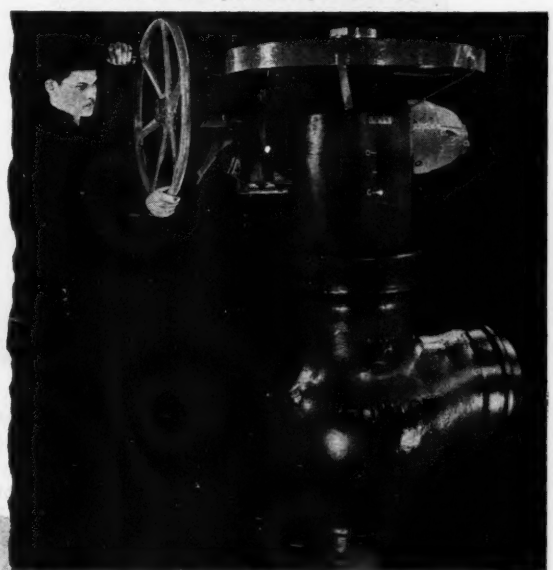
The Valve that MEETS the HIGHER-PRESSURE TEMPERATURE CONDITIONS of the Future *Now*

PROBLEM: The steady trend toward constantly higher temperatures and pressures puts particular strain on valves. Many designers are laying out projects to operate initially at high, but not excessive, pressures and temperatures, but want equipment installed now to be suitable for more severe service later.

SOLUTION: Here is one Edward answer to the problem. While keeping the proved principles of Edward disk guiding, patented Edward Impactor handwheel, hour-glass disk-piston and other exclusively Edward design features, these Edward non-return valves incorporate many design innovations. Among them are pressure-sealed bonnets, closure indicators, enclosed bonnets and yokes, flow directional guiding, and redesigned internal contours for lowering further the already low pressure drop which is characteristic of Edward valves.

RESULT: Compact, functional and dependable, this valve design is but one of several Edward offers for extreme service conditions. If you are designing for tomorrow's problems today, it will pay you to get in touch with an Edward engineer, and to have the new Edward Catalog No. 12.

Pressure-sealed bonnet non-return valve with exclusive Edward Impactor handwheel. Valve weighs only 40% of standard flanged type of same size and pressure class. Internal parts easily removed.



Motor-operated remote control non-return valve built for new Midwestern high temperature-high pressure power project. Body-bonnet connection tight at highest temperature.

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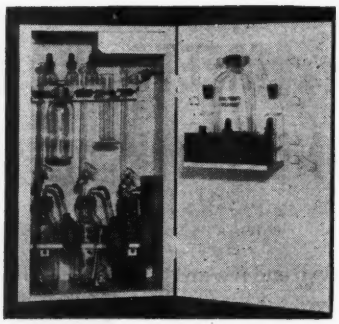
Water Testing Unit

A COMPACT, economical but completely equipped "Testmaster Junior" for water analysis has been developed by TruTest Laboratories, 261 S. 3rd Street, Philadelphia, Pa., which makes essential tests possible for hardness, alkalinity to P & M and chloride for maintaining suitable boiler feed or process water conditions.

This new cabinet is a simplification of "Testmaster," retaining the parent model's compactness and flexibility as well as its major functions. For any plant where hardness, alkalinity to P & M and chloride determinations are adequate for dependable water control, "Testmaster Junior" contains in one arranged cabinet complete apparatus and reagents for making

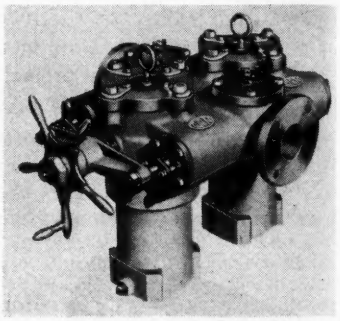


these tests. Where it is desired to incorporate wide range PH determinations and phosphate determinations, "Testmaster Junior" is so designed that the same cabinet, without modifications, will accommodate the TruTest phosphate tray and the TruTest pH test unit, making it potentially available for all normal water control tests except dissolved oxygen in a completely portable and equipped unit.

Duplex Strainer

A DUPLEX VERTICAL chamber disc type pipeline strainer, the product of J. A. Zurn Mfg. Co., Erie, Pa., has been designed to assure continuous flow in pipelines, and is operated by a large handwheel that reverses valves simultaneously with minimum pressure drop. Capacity flow is assured at all positions of the operating handwheel.

The strainer basket is in an eccentric position with respect to the basket chamber, so that the flow section is proportional to the flow needs at all points, thus minimizing pressure



drop. Removable covers provide easy access to the basket chamber and permit easy and complete cleaning. Large handholes above each valve assembly permit servicing of the valves without removing the strainer.

This unit protects all types of pumps, traps, valves, regulators, asperators, injectors, control units and other primary equipment. It is made in cast bronze, steel, semi-steel, and cast iron; the basket, of perforated brass, monel or other specified metals.

Asbestos Gaskets

TO THE LINE OF Palmetto packings has been aded high-pressure folded asbestos gaskets, asbestos metallic sheet packing, and asbestos metallic gasket tape, all made by Greene, Tweed & Co., 238th St. and Bronx Blvd., New York 66, N. Y.

Palmetto high pressure folded asbestos gaskets, for handholes, manholes and tube plates of boilers and other apparatus subject to heat and pressure, have two features of particular importance. Each gasket is handblocked to accurate size, and the seam is on the outside, away from pressure. These gaskets are made from brass wire inserted asbestos yarn, woven into a strong cloth, coated and cemented with a heat-resisting compound, folded and pressed into shape. The materials and methods of manufacture of these gaskets provided resilience and compressibility.

The woven clothfrom which these gaskets are made is also available in sheet form as palmetto asbestos metallic sheet packing. These sheets are supplied with a heat-resistant coating and are suitable for cutting gaskets for cylinder heads of gas, oil and steam engines, and for similar services.

Palmetto asbestos metallic gasket tape is also made from the same cloth. This folded tape is coated with

Transformer Designed to Facilitate Shipping

THIS SINGLE PHASE, 35,000-kva power transformer, one of four built by General Electric for The Ohio Power Co., permits shipment of the units completely assembled with the exception of the lightning arresters. The new design, featuring the unusual location of bushings and the use of detachable forced-oil, forced-air cooling units, made it possible not only to effect a drastic reduction in height, in order to meet shipping clearances with bushings in place, but to reduce bulk and weight to be handled in installations as well. The unit is rated 60-cycle, 35,000 kva, 138,600 high-voltage, to 69,300 low-voltage with a 7200- v tertiary winding for delta connection. Three of these autotransformers will comprise the 105,000-kva bank in the company's Tidd Plant at Brilliant, Ohio.

Better because it's Seatless

Why has this blow-off valve become "standard" in over 12,000 boiler plants? Why is it today the universal choice of leading engineers for new boiler installations?

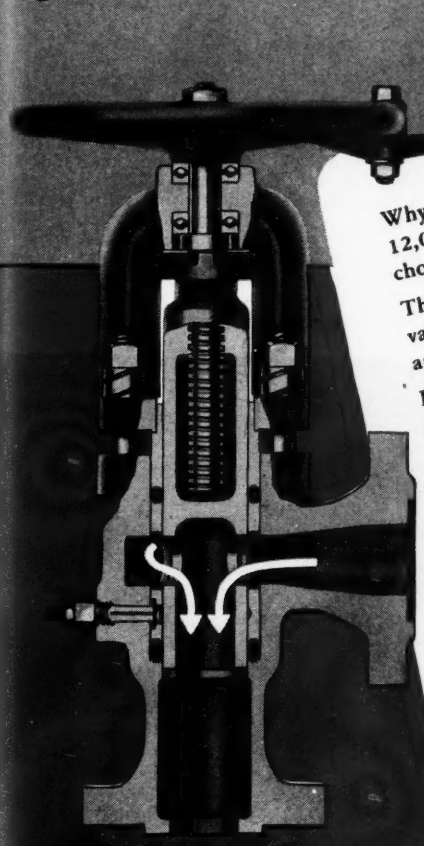
The answer is in the engineering reason behind the valve. It is *SEATLESS*. There is no seat to score, wear and clog with mud, scale and dirt.

Power plant operators hailed this seatless-design valve more than 25 years ago when it was first introduced. It eliminated a source of continual trouble and expense common with conventional type blow-off valves.

Since then constant mechanical and metallurgical research, aimed to meet new and more rigid service requirements, has made improved Yarway Seatless Blow-Off Valves the last word in insurance against boiler blow-down troubles.

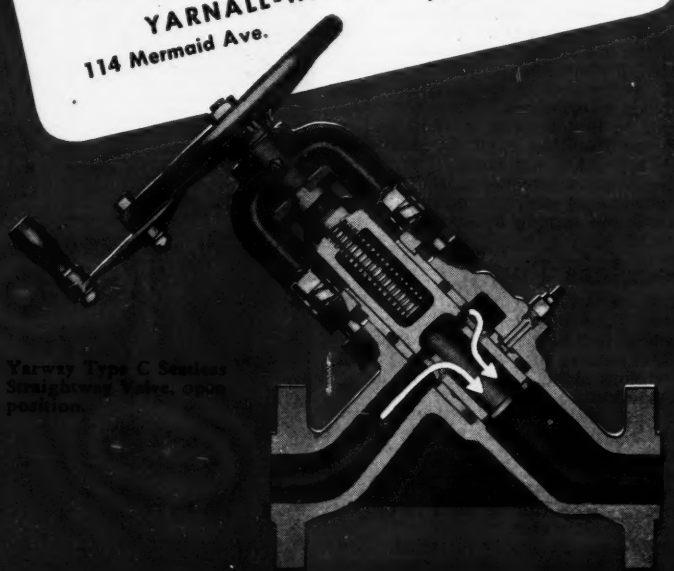
See Yarway Blow-Off Valves, hear the seatless principle explained by Lowell Thomas in Yarway's color motion picture "There Is An Engineering Reason." It's available without charge for group showings. Write today.

YARNALL-WARING COMPANY
114 Mermaid Ave. **Philadelphia 18, Pa.**



Yarway Type C Seatless Angle Valve, open position.

Yarway Type C Nitralloy Renewable Guards and Integral Seating Rings.



Yarway Type C Seatless Straightway Valve, open position.

YARWAY BLOW-OFF VALVES

heat-resisting compound, and is particularly convenient for making gasket strips, such as required along the lip of large rectangular tanks.

Phosphate Test Set

THE NEW PHOSPHATE TEST set, manufactured by La Motte Chemical Products Co., Towson 4, Baltimore, Md., is designed for the determination of ortho phosphate and for the determination of meta, pyro and poly phosphates that the being used for an increasingly large number of industrial purposes. This outfit is representative of the simplified system of testing apparatus originated by the LaMotte Laboratories, by which chemical tests, that have heretofore been confined to the laboratory analyst, have been simplified to a degree that the field man and the non-technical operator are able to make accurate control tests a part of their daily routine.

Equipment for this unit is assembled in the standard LaMotte pH Block comparator. Only two reagents are employed in the test and one of

these is in the form of small, accurately compounded tablets. The color standards are 10 in number and, by a dilution procedure, they cover concentrations of phosphates from 1 to 100 ppm. The interval from 1 to 10 ppm is in steps of 1 ppm, and from 10 to 100 ppm the standards are in steps of 10 ppm. The range from 1 to 10 ppm is employed when testing polyphosphates while the higher range is useful for regulating the phosphate treatment in boiler water.

In the determination of ortho phosphates, a measured sample is diluted with water and is treated with the molybdate solution. The reducing agent, in tablet form, is then added and the resulting color is compared with the color standards. Polyphosphates require conversion to the ortho form which is easily accomplished by heating the sample in acid solution.

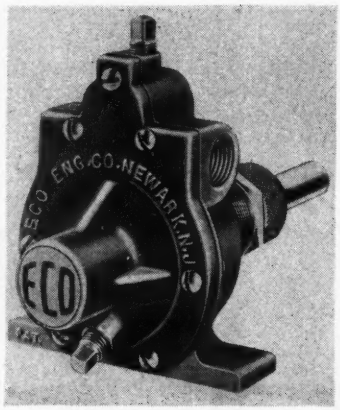
Gearless Pump

AN IMPROVED gearless pump for water, light oil or other liquid circulating use has been introduced by ECO Engineering Co., Dept. 114, 12 New York Ave., Newark 1, N. J.

One feature of the new pump is the fact that it is equipped with special bearings which require only water lubrication, eliminating the need for grease cups. No adjustments are needed. All metal is of bronze. Pump can be used in oil, or fresh or salt water.

Pump can be easily installed. Can be mounted at any angle and operated in either direction with equal efficiency, and opening of face plate allows quick removal of any obstructing material.

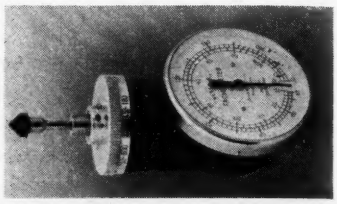
The impeller, which is a removable unit, is tough resilient material composed of several layers of laminated



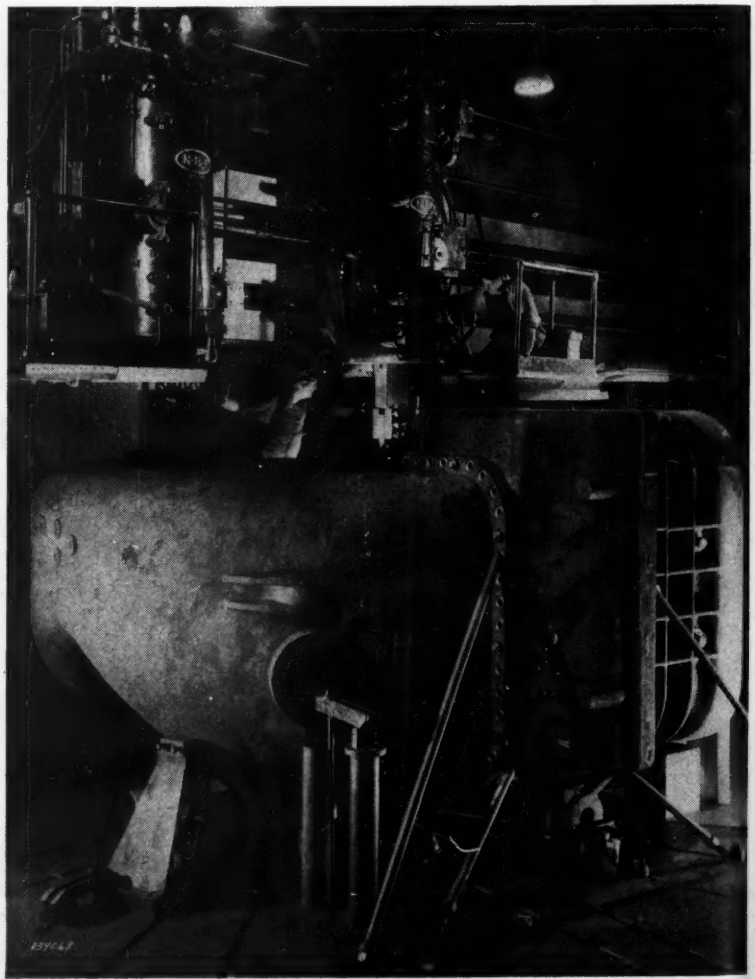
sections, vulcanized together under great pressure. The ECO gearless pump is available with single impeller and standard 1/2-in. connection and double impeller with standard 1-in. connection.

Precision Tachometer

ANNOUNCED AS A new precision, direct-indicating hand tachometer, this instrument, developed by James G. Biddle Co., 1211 Arch Street, Philadelphia 7, Pa., has two scales and five different ranges viz: 45 to 180



rpm; 150 to 600 rpm; 450 to 1800 rpm; 1500 to 6000 rpm; and 4500 to 18,000 rpm. Change of range is by rotation of knurled barrell head. The instrument is supplied complete with carrying case and accessories including a six-inch circumference wheel for measuring surface speeds.



STEAM TURBINE exhaust end assembly being machined on a big Allis-Chalmers' 40 ft boring mill. It is a major part of one of the new single-cylinder 20,000 kw, steam turbines designed for a mid-west utility.

BURGESS SNUBBER BULLETIN for Diesel Exhaust Noise Control

A TYPICAL CAUSE OF POOR ENGINE PERFORMANCE

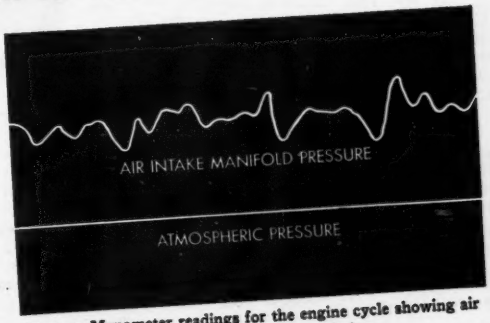
In previous articles we have discussed the effect of the Burgess Snubber on the air intake of a Diesel engine or compressor . . . how the Snubber is used to eliminate resonance, ramming, and pulsations in the air intake system.

Some air intake problems are simple to solve . . . others are particularly knotty, in which case the Burgess engineer is frequently called for consultation and advice.

One interesting problem recently developed in a Diesel electric power plant equipped with a low speed, heavy duty, two-cycle, 10-cylinder Diesel engine with separate scavenging centrifugal blower. Complaints on the installation developed because of a pronounced low frequency pulsation in the air intake of the centrifugal blower. The low frequency pulsation was exactly opposite of what might be normally expected, since the blower speed was 3600 rpm and engine speed only 300 rpm.

The engine was equipped with an oil bath air filter and the pulsations were severe enough to splash oil out of the cleaner oil pan. Also, the audible low frequency sound emitted from the blower intake caused visible vibration of objects adjacent to the filter house.

Before the Burgess engineer was called in, the utility undertook to solve their own problem by installing a second oil bath air filter. This improved the condition only slightly.



Burgess Manometer readings for the engine cycle showing air intake manifold pressure variations.

Burgess manometer tests showed that the pressure fluctuations were having no serious effect on engine scavenging, because the air intake manifold pressure was constantly well above atmospheric pressure. The pulsations, therefore, must be the result of a scavenging condition reflected back through the air intake system.

At the conclusion of the tests, the Burgess engineer suggested the installation of a Burgess Snubber to eliminate the air intake noise and reduce the pulsations in the air intake system.

The Burgess manometer, which records instantaneous pressure fluctuations and provides readings at any point during the engine cycle, has solved many similar air intake and exhaust problems on Diesel engines.

* * *

BURGESS EXHAUST SNUBBER STC SERIES

The STC Series Burgess Snubber is standard for exhaust systems of internal combustion engines, blowers, and vacuum pumps which discharge to atmosphere. The construction of the STC Series Snubber is based on the most advanced knowledge of hydrokinematics of exhaust systems.

The Burgess principle of silencing is based on the theory of "snubbing" the slug of exhaust gas . . . hence the name, Snubber. The slug of fast-moving exhaust gas passes through successive snubbing chambers where the kinetic energy of the exhaust gas is dissipated so that it reaches the atmosphere in a quiet, steady flow. With the Burgess Exhaust Snubber, there is no need to tune the exhaust system to overcome bad exhaust effects.

There is no "second best" Burgess Snubber line. The combination of fine engineering talent and high quality materials can result in only one design and one manufacturing standard. The Burgess STC Series Exhaust Snubbers are constructed of heavy gauge steel and welded throughout to combine strength and lightweight. A typically important Burgess construction detail is the mechanically rigid dome-head construction . . . scientifically correct for the ideal Snubber.

Diesel engine men can do well to investigate the Burgess Snubber line. Burgess engineers will be glad to recommend the correct exhaust Snubber for any engine application.

NEW BOOKLET TELLS A STORY OF SOUND

Diesel engineers and operators of Diesel engines will be interested in reading the new 36-page Burgess-Manning booklet, "A Story of Sound," just released for distribution.

"A Story of Sound" discusses such subjects as: What is sound? What are sound waves? Why are sound waves different? How can we measure sound? What is a sound level? What is a decibel? What does an acoustic engineer do?

"A Story of Sound" is valuable to the Diesel engineer for a better understanding of noise problems. Copies are now available upon request.

Published by BURGESS-MANNING COMPANY Chicago, Illinois

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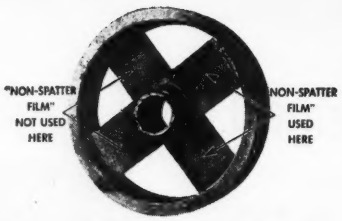
Non-Spatter Welding Film

A LIQUID DESIGNED to minimize the adherence of welding spatter to metal and reduce cleaning time has been introduced by The Lincoln Electric Co., Cleveland, Ohio.

This new product, known as Lincoln "Non-Spatter" Film, is claimed to possess the following characteristics: welding can proceed after application, whether the film is still wet or dry; film can be sprayed or painted on work; priming coats of paint may be readily applied over the film; if it is desired to remove the film before painting, this can be readily accomplished by washing with water; one application of film is effective for multiple-pass welding; if film is sprayed or painted on parts prior to being normalized, the oxide film and ordinary scale can be removed more



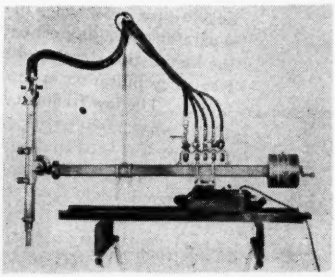
easily after heat treating; material will freeze but freezing has no effect on its properties when thawed out.

Supplied in concentrated form, the material is diluted with water and applied with either brush or air gun to the areas adjacent to the joint to be welded and to welding jigs that may be subjected to spatter. After welding, the spatter can be easily removed by wiping or brushing, thus reducing cleaning time to a minimum.

Machine-Cutting Blowpipe

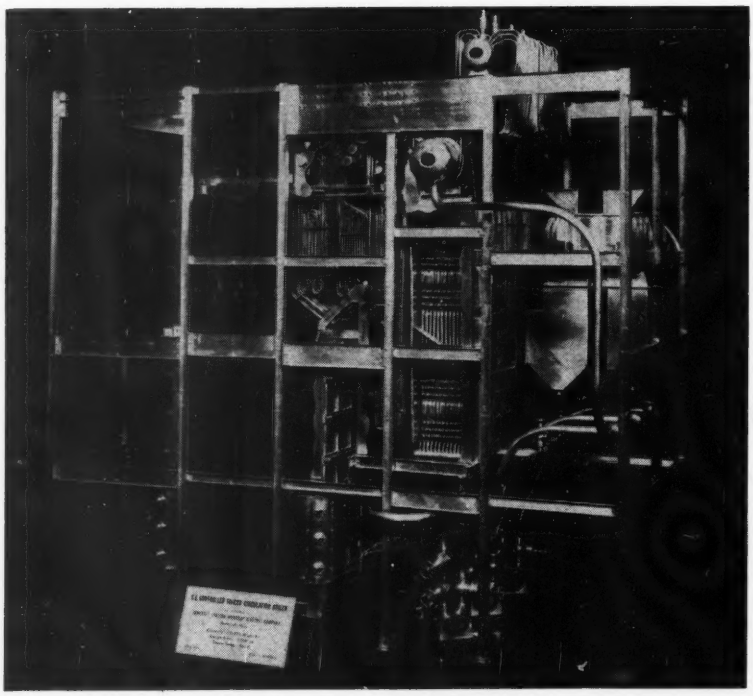
A NEW HEAVY-DUTY, oxy-acetylene cutting blowpipe, the Oxweld C-45 machine-cutting blow-pipe, has been developed by The Linde Air Products Co., Unit of Union Carbide and Carbon Corp., 30 East 42nd St., New York, N. Y. This blowpipe, which cuts steel ranging in thickness from 16 in. to 50 in., is particularly suited for scrap cutting in many applications where the oxygen lance was formerly required.

The C-45 is water cooled and is intended to be mounted on a heavy-duty, straight-line cutting machine such as the new Oxweld CM-37 machine or the Oxweld CM-21 cutting machine. A 50-lb gage is attached to the blowpipe body for checking cutting-oxygen pressures which are unusually low—never over 35 psi.



The C-45 blowpipe is designed for operating with medium-pressure acetylene and will operate satisfactorily on a generator or a manifold having a minimum hourly capacity of 500 cu ft of acetylene. Unless cutting oxygen is supplied from a pipe line, at least 10 cylinders should be manifolded to provide sufficient capacity. In shops where steel over 18 in. thick must be cut frequently, the C-45 blowpipe provides a tool for making these cuts quickly and economically.

Also available is the blowpipe holder, which has been designed especially for this blowpipe. It provides ease, accuracy, and stability in making vertical and angular adjustments. Vertical adjustment is obtained by turning a ball crank which operates a worm and gear that meshes with the blowpipe rack. A total angular adjustment of 135 deg can be obtained in the plane of the cut.



Montaup Boiler

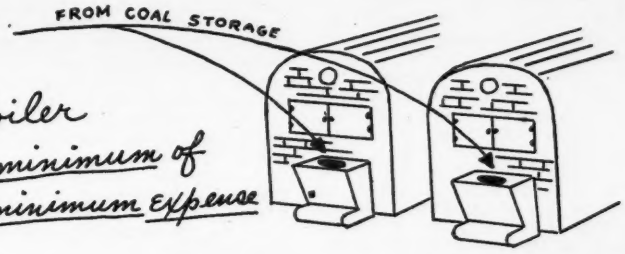
MONTAUP BOILER in scale model form has recently been completed. This steam generator has a capacity of 650,000-lb per hr 1800-psi, and is a controlled forced-circulation steam-generating unit installed at the Somerset Station on the Montaup Electric Co., Somerset, Mass., engineered by Stone & Webster. The model, constructed of aluminum and occupying a space approximately 3½ by 2½ by 3½ ft, required about 7000 man-hours plus 2000 supervisory hours to build. Being an exact replica of the original unit which involves over 22 miles of tubing, the model contains over a mile of tubes, the fabrication of which required special tools, particularly with reference to the bifurcated fin tubes of very small diameter. A special machine was also built to roll the nipples and tubes in the drums and headers.

The model was made by E. C. Keithley of Combustion Engineering Co., who has constructed many other models of C-E stationary and marine boilers, including one of the million pound per hour high-pressure Ford units. All these models have been constructed in the basement workshop of Mr. Keithley's residence in Detroit. The model of the Montaup unit is now in the reception room of the Combustion Engineering Co. office.

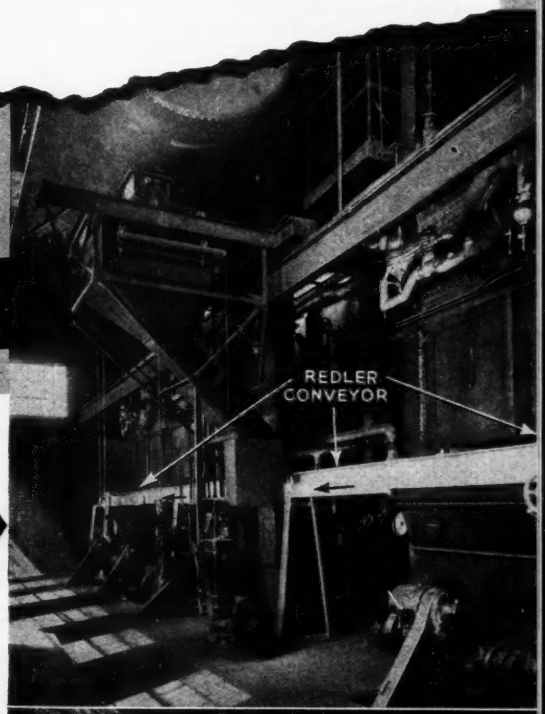
Universal Gasket

A NEW GASKET MATERIAL, called Plastic-Gasket is now manufactured by Flexrock Co., 3623 Filbert St., Philadelphia 4, Pa., which can be applied to surfaces of flanges, etc., about 1/64 in. thick, with knife or fingers. Plastic-Gasket may be applied over ordinary gaskets to increase their effectiveness and preserve them, so they can be re-used. It is claimed that Plastic-Gasket prevents leakage, oxidation, corrosion; will not dry out, burn out or blow out, and is unaffected by temperature and pressure. Joints sealed with Plastic Gasket never "freeze," it is claimed, and can easily be "broken" at any time. Six pounds of Plastic-Gasket covers, approximately, 6000 sq in., 1/64 in. thick.

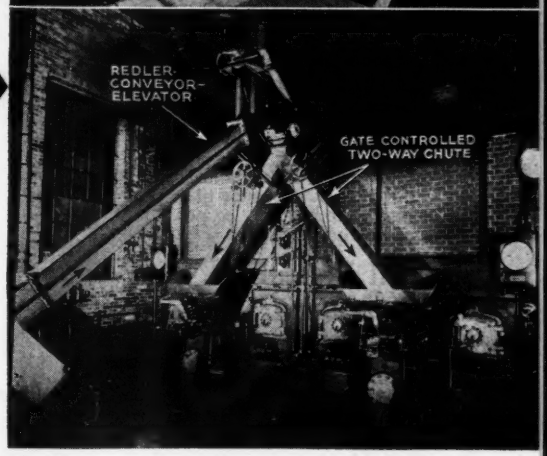
The Problem —
to feed coal to boiler hoppers with a minimum of Equipment at minimum expense



Two Examples of how Redlers Save both SPACE and MONEY



In this boiler room, a long horizontal S-A engineered REDLER Conveyor is mounted over the hoppers. It feeds directly into them, and runs the full length of the room. It not only feeds coal by the most direct route, but it also keeps coal dust enclosed within sealed casings. As is the case with many such REDLER Systems, this particular installation eliminated the need for a large overhead bunker and a weigh larry.



Here again S-A equipment not only saves space but moves coal rapidly, without dust, and with a minimum of equipment. This power plant is making good use of a horizontal-inclined REDLER Conveyor-Elevator, which feeds coal from a large cylindrical bin to twin stokers. The flow of coal is controlled by a gate regulated two-way chute.

Let these examples of how REDLERS save space, eliminate dust, and reduce the need for bulky equipment suggest ways that S-A engineering and S-A equipment can do a comparable job for *you.* Write us today.

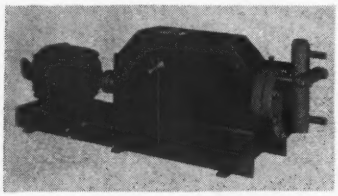
STEPHEN S-A ADAMSON MFG. CO.

515 RIDGEWAY AVENUE, AURORA, ILLINOIS · LOS ANGELES, CALIF. ★ BELLEVILLE, ONT.

Designers and Manufacturers of All Types of
BULK MATERIAL HANDLING EQUIPMENT

Proportioning Pump

THE NEW Type DEL Wilson Pulsafeeder has been announced by Lapp Insulator Co., Inc., LeRoy, N. Y. This proportioning pump is designed for heavy duty chemical solution feeding against high pressures up to 5000 psi, with a constant, manually adjustable rate of feed. Type DEL Pulsafeeder is a horizontal,, direct motor drive, positive displacement, reciprocating diaphragm type chemical proportioning pump. Corrosion-free materials are used in the construction of the reagent heads, which include an exclusive hydraulically-balanced diaphragm. This diaphragm is actuated



by piston displacement through a hydraulic fluid. Displacement is accurately measured by the piston in the cylinder. There is no mechanical connection or pressure differential against the diaphragm at any time. Packing glands are eliminated. Chemical solution is completely isolated from operating parts.

Micrometer stroke adjustment of the piston permits adjustment of rate of flow from zero to full maximum, while the machine is in operation, with accuracy of flow maintained throughout a range from minimum to maximum of 1:100. Motion is transmitted to the piston by an oscillating arm which utilizes full motor power without friction or vibration. Piston drive transmission assembly is sealed in a heavy duty cast iron housing, submerged in an oil bath.

Type DEL Pulsafeeders are available with one reagent head for single feed or two reagent heads for feeding two chemical solutions simultaneously. On duplex units the two reagent heads are driven from a single motor and may be adjusted while in operation to a uniformly synchronized rate of flow or to varying rates of flow. Five sizes are manufactured which provides a selection of capacities ranging from a few cc per hour to 10 gal per hour.

Special Length Boiler Tubing

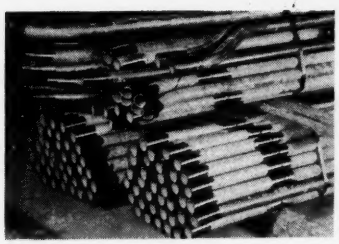
BY THE USE of oxy-acetylene pressure-welding, boiler tubing, tailormade to any desired length, is now fabricated from standard-length tube stock, it has been announced by the Linde Air Products Co., 30 East 42nd St., New York, N. Y. Besides welding short lengths of tubing to standard 20-ft lengths one boiler manufacturer also uses the process to join together standard lengths. In this manner continuous tubing 95-ft in length has been produced. Production delays can now be avoided since tube stock of suitable length is readily available.

In welding with this process, squarely cut surfaces are butted together under pressure. While this pressure is maintained, the joint is heated by means of a ring of oxy-acetylene flames to a high temperature but below the melting point of the steel. Increased pressure is then applied to the work by means of a hydraulic pump and continued until upsetting of the joint occurs, producing a weld of high quality.

Work is clamped in the oxy-acetylene pressure-welding machine by means of two split jaws. A special open ring-type heating head is provided, also a control valve for the gases. The hydraulic pressure applied to the clamping and push-up pistons is provided by the pump.

The ends of the tubing to be pressure-welded are prepared for welding by a simple cut-off operation done on a lathe. In this manner, clean, squarely mated edges are produced. Such careful edge preparation is necessary for making consistently strong welds in tubes subject to high temperatures and pressures. With the two lengths of tubing clamped into the machine, the initial pressure is applied and the welding flames are lighted. During the heating operation the welding operator positions the welding head directly over the joint. A slight lateral movement of the head is used during the last seconds to prevent any local overheating or excessive surface fusion. The pressure on the joint is controlled by a helper.

Both heating and pressure are maintained until plastic upsetting occurs. The weld is completed when a predetermined amount of shortening has occurred in the workpiece. The joint is then welded and the flames turned off. An initial pressure of 900 psi which is gradually increased to 2200 psi is used in upsetting this material. The tubes are stress-relieved by simply reheating the cooled welded areas to a dull red heat and allowing them to cool slowly in air. After being welded and stress-relieved the pipes are bent to the proper shape and are then ready for installation. A supply of such tailormade tubing is shown in the illustration.

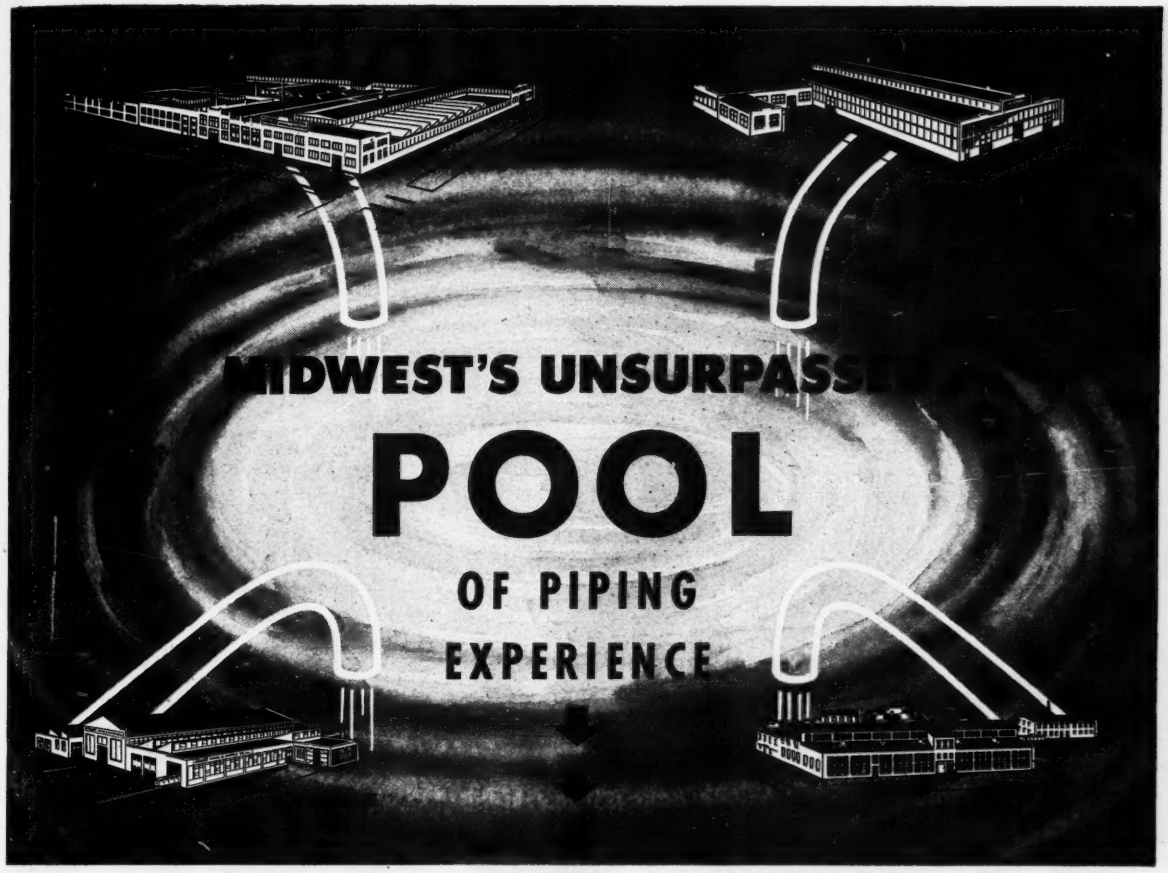


Refractory Lining

BASIC REFRACTORIES, INC., 845 Hanna Building, Cleveland, O., has recently developed a material called Zircoat-M which is a zirconium silicate base refractory for application with a spray gun. It sets up rapidly to form a hard, dense working surface that will withstand high furnace operating temperatures and unusual furnace conditions. It is a fine grained material shipped dry in 100 lb bags. Zircoat-M is mixed with water for spraying and has been extensively used as a protective coating on silicon carbide, fireclay, sillimanite, mullite, silica, and other acid type refractories.

This new material has been used successfully in boiler furnaces to protect brickwork that is exposed to severe flame impingement and corrosive action of clinker or fly ash.

PURCHASE OF THE Beaumont Iron Works Co. of Beaumont, Tex., by the American Locomotive Co., announced September 27 by D. W. Fraser, president of the locomotive concern gives the locomotive builder seven manufacturing plants in the United States and adds substantially to the company's facilities for servicing the oil industry in the southwest. The line of oil well drilling and production equipment manufactured by Beaumont will be continued by American Locomotive Co. The locomotive company is a builder of heat exchangers, pressure vessels, and prefabricated pipe.



ASSURES the User BETTER PIPING

Continuous interchange of experience data and manufacturing information between Midwest's four pipe fabricating plants results in a pool of piping experience that is unsurpassed by any other organization.

Each plant is fully equipped to do a complete job of pipe fabricating—is staffed by piping experts of long experience and high qualifications. Each plant is always striving to improve its product. A friendly rivalry acts as a stimulant.

Information on new processes and techniques, solutions to unusual piping problems, and generally useful data are exchanged between these plants. One plant will develop an improvement in welding procedure for a difficult alloy . . . another will build a new fixture for saving time in welding . . . etc. For many years this exchange has been building up an unsurpassed pool of piping experience and "know how."

This is just one of several reasons why Midwest can do a better piping job for you . . . whether you want a simple bend or piping for an entire plant installed without divided responsibility.

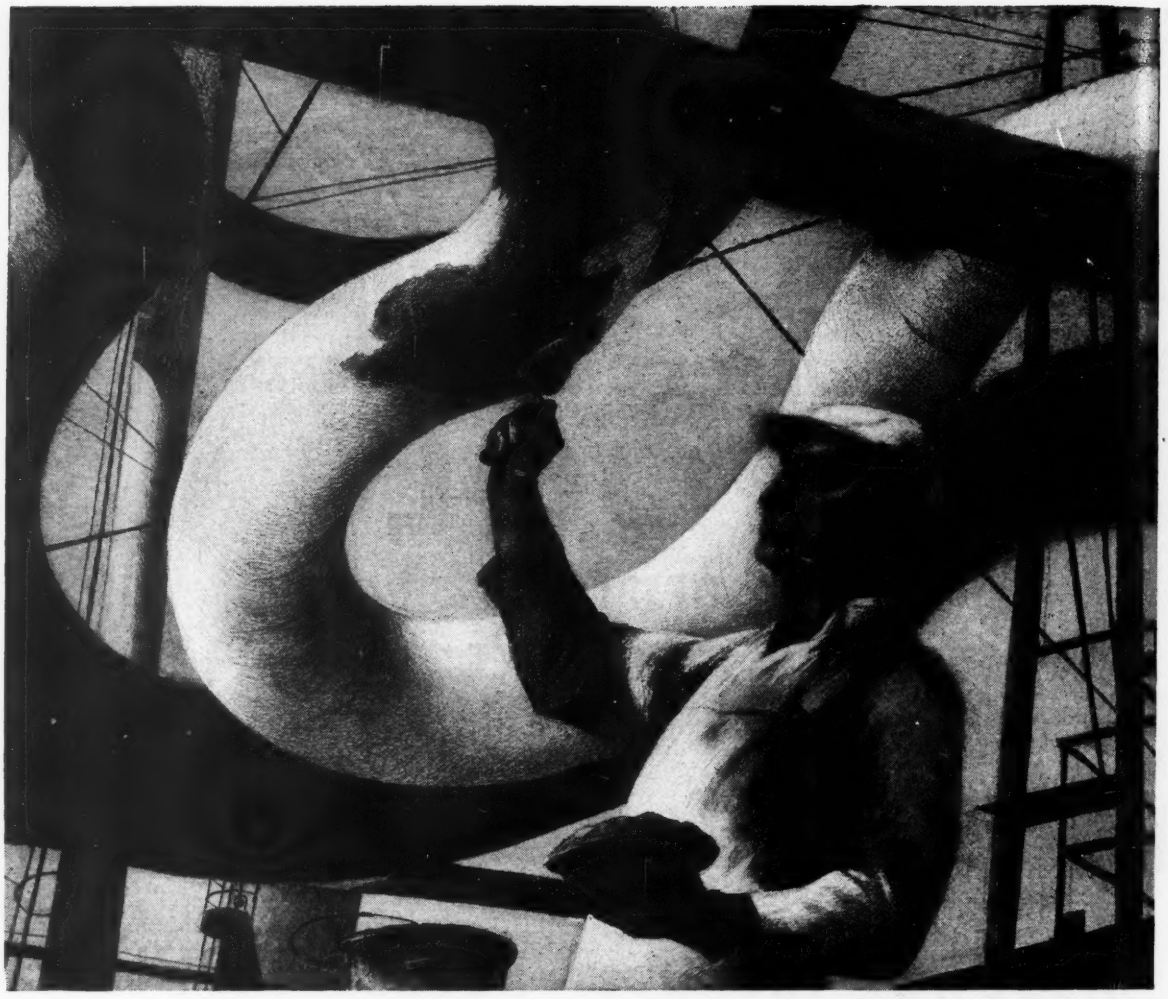
MIDWEST

PIPING & SUPPLY CO., INC.

Main Office: 1450 South Second St., St. Louis 4, Mo.

Plants: St. Louis, Passaic (N. J.) and Los Angeles • Subsidiary: Lumsden & Van Stone Co., South Boston 27, Mass. • Sales Offices: New York 7—30 Church St. • Chicago 3—645 Marquette Bldg. • Los Angeles 33—520 Anderson St. • Houston 2—229 Shell Bldg. • Tulsa 3—523 Mayo Bldg. • Atlanta 3—Rod Rock Bldg. • South Boston 27—426 First St.

PIPING FABRICATORS AND CONTRACTORS



ORIGINAL LITHOGRAPH BY BENTON SPRUANCE

PROTECT YOUR *Insulations*

Surprisingly large amounts of good pipe and boiler insulation are ruined each year by lack of proper protection against weather, moisture and mechanical damage. And broken, sagged or damaged coverings are but little better than no coverings at all. Even the best of insulating materials, such as Ehret's 85% Magnesia and Enduro, should be adequately protected in order to maintain insulation efficiency and prevent disintegration and destruction.

It will pay you well to make certain that your insulations, both indoors and out, are maintained in the best of condition and repair. Ehret approved contractors and distributors throughout the country stand ready at all times to help you with this responsibility.

THE EHRET HEAT INSULATION HANDBOOK *contains a wealth of information on 85% Magnesia, Enduro high temperature and many other insulations—with selection and application data for boilers, piping and equipment. Fully illustrated, it includes heat loss and efficiency tables, specifications and recommendations for every temperature condition. A copy will be sent at your request.*

EHRET

MAGNESIA MANUFACTURING CO.

VALLEY FORGE • PENNSYLVANIA

ON BRANCH PIPE OUTLET JOBS

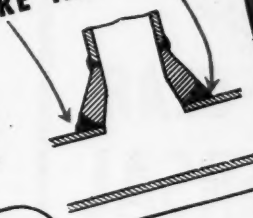
Check these Advantages of WeldOlet Fittings . . .

No Templates OR FORMING OF PIPES

EASY INSTALLATION—WeldOlet Fitting serves as template. Just four easy steps with the WeldOlet Method and you get strong, permanent, leak-proof branch pipe outlets.

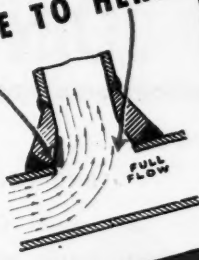
Extra Strength — HERE AND HERE

FULL-STRENGTH JOINTS—The patented construction of WeldOlet Fittings brings every joint to original pipe strength.



Full Flow Area — HERE TO HERE

FULL FLOW AREA—The funnel-shaped inlet into the branch pipe allows unrestricted flow. WeldOlet Fittings reduce turbulence and friction to a minimum.



USEFUL INFORMATION

Ask for your free copy of this useful WeldOlet Fittings Catalog. Just published, it contains installation instructions and information on sizes and types of fittings available. Just drop us a note on your company letterhead.

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Forged Fittings Division* • BONNEY FORGE & TOOL WORKS • *639 N. Meadow St., Allentown, Pa.

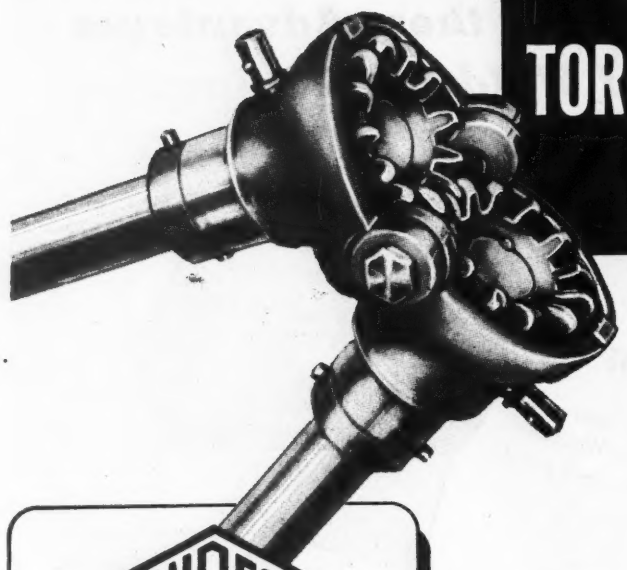
WELDOLETS

TRADE MARK REG. U. S. PAT. OFF. PAT. IN U. S. & FOREIGN COUNTRIES

WELDING OUTLET - THREADED OUTLET - SOCKET OUTLET

For Welded Branch Pipe Outlets

POSITIVE • SAFE TORQUE TRANSMISSION THROUGH 135°



Through **360°** on **HORIZONTAL CENTER LINE**

CONSECO

BEVEL GEAR UNIVERSAL JOINTS

SEND TODAY

for our Bulletin CS-10, giving complete details about Conseco Bevel Gear Universal Joints.

Avoid accidents to your men by making it unnecessary to climb ladders or work in hazardous locations to operate valves, pumps, ventilators and other inaccessible units. Conseco Bevel Gear Universal Joints offer a simple, flexible solution to the problem of remote control of inaccessible units and for centralized control of widely separated units. They provide safe, positive torque transmission through 135° on vertical centers, and through 360° on horizontal centers, without additional or special gears.

A wide range of standard sizes, from ½ to 1½ in., with capacities from 1580 to 4938 inch pounds at 49 rpm are available. Conseco Bevel Gear Universal Joints are simple to install. Precision machine-cut manganese-bronze gears with minimum backlash assure long, safe, trouble-free service without maintenance. Thousands of Conseco Bevel Gear Universal Joints are saving time and labor ashore and afloat. More of them are in use than any other gear.

A highly skilled, specially equipped service organization, ready for immediate action anywhere on the continent, backed by engineering and manufacturing facilities producing over 3,000,000 sq. ft. of heat exchangers annually.

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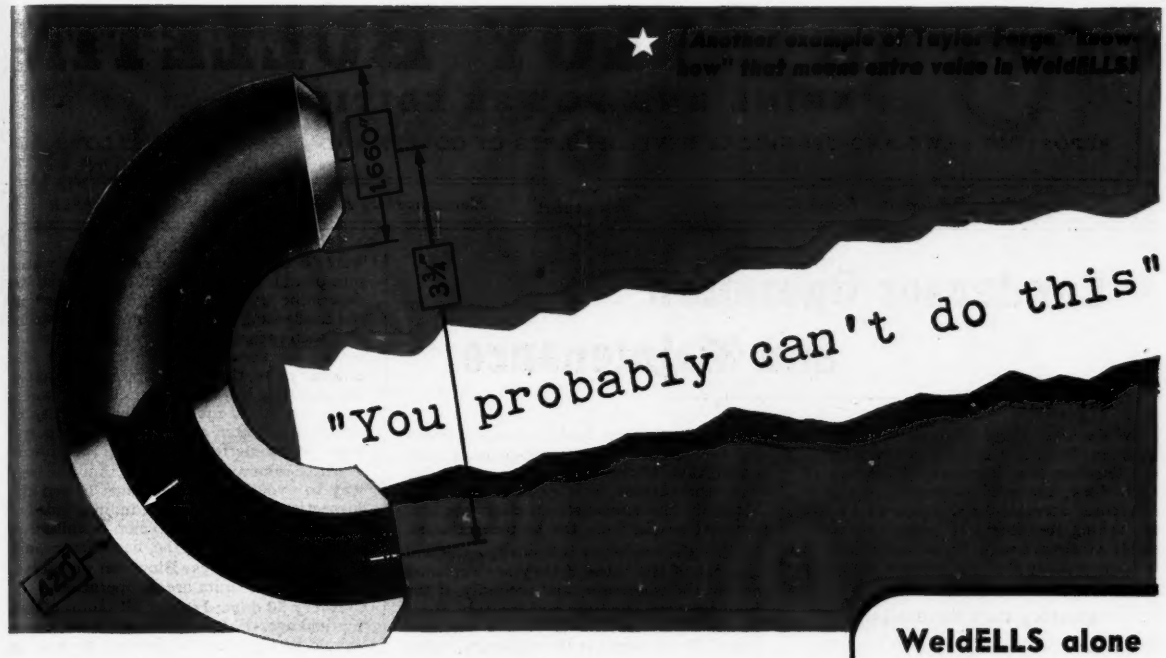


....but we did!

★ *That, in effect, is what people occasionally have said when putting some tough specification before us . . . but if they were trying to stump someone they came to the wrong place!*

The fitting pictured above is a good example of this. As far as we know, no one else ever tried to forge a welding elbow or return bend having such great wall thickness in relation to the size of the fitting. There was good reason to doubt if it could be made, because such fittings simply couldn't be formed by the processes ordinarily employed in making welding fittings.

But special methods, developed by Taylor Forge, made this easy for us. It was another example of "You say it can't be done—but here it is!"

IN our standard, stock line of welding fittings, as in this special heavy wall return bend, you also find a combination of features that could not be achieved by the processes ordinarily employed in making welding fittings.

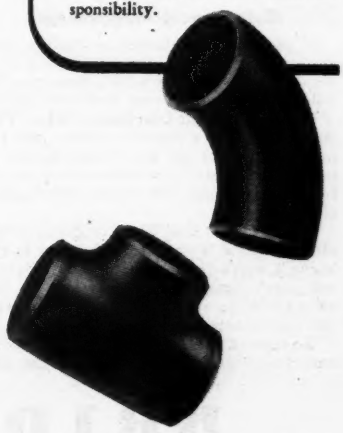
Take the selective reinforcement of the zone of highest stress in WeldELLS, for instance . . . or the tangents which help so much in lining up and welding . . . or the final truing operation which gives those extremely accurate dimensions.

These are features which eloquently attest to the "know-how" of Taylor Forge acquired in more than 40 years of handling just about every conceivable kind of forging problem in the piping field. Read the entire list of features opposite and we believe you will agree that

WeldELLS have everything

WeldELLS alone combine these features:

- **Seamless** — greater strength and uniformity.
- **Tangents**—keep weld away from zone of highest stress—simplify lining up.
- **Precision quarter-marked ends**—simplify layout and help insure accuracy.
- **Selective reinforcement** — provides uniform strength.
- **Permanent and complete identification marking**—saves time and eliminates errors in shop and field.
- **Wall thickness never less than specification minimum**—assures full strength and long life.
- **Machine tool beveled ends**—provides best welding surface and accurate bevel and land.
- **The most complete line of Welding Fittings and Forged Steel Flanges in the World** — insures complete service and undivided responsibility.



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COPPER ALLOY BULLETIN

MARINE AND POWER EDITION

REPORTING NEWS AND TECHNICAL DEVELOPMENTS OF COPPER AND COPPER-BASE ALLOYS

Prepared by Bridgeport Brass Company "Bridgeport" *Headquarters for BRASS, BRONZE, and COPPER*

Condenser Operation and Maintenance

In the 1945 Ships Manual Mr. H. M. Graham, President and Chief Engineer of the Graham Manufacturing Company of New York, discussed important factors in condenser operation and maintenance. We are taking the liberty of presenting some of Mr. Graham's suggestions for the benefit of Copper Alloy Bulletin readers, who may not have seen the article.

Starting Up a Condenser

1. Start condenser in advance of turbine operation and before any equipment that exhausts into same.
2. Check all atmospheric and vent valves to make sure that same are closed.
3. Check hotwell water level—same should be approximately half full as indicated on hotwell gauge glass. (In starting up a condenser for the first time fresh water may have to be introduced into the hotwell.)
4. Open valve in cooling water recirculating line from hotwell to air ejector inter and after condenser.
5. Start circulating water pump going after opening valves in circulating water line.
6. Start condensate pump as soon as turbine is exhausting steam into the condenser and control level of condensate.
7. Start up air ejector.

Shutting Down a Condenser

1. Steam turbine or any other source of steam to the condenser must be shut off before shutting down condenser.
2. Shut off steam to air ejector.
3. Stop condensate pump.
4. Close valve in cooling water recirculating line.
5. Shut down circulating water pump.

Maintenance Suggestions

If properly maintained, a surface condenser will generally give satisfactory service. In the event of trouble, however, the following procedures may be found helpful.

1. Fouling of the Condenser Tubes: This is evidenced by a loss of vacuum; and the manhole covers on the water boxes, or possibly the water boxes themselves, should be removed and the tubes thoroughly cleaned.

2. A Leaky Tube: This trouble is generally indicated by constant flooding of the hotwell, and when the circulating water is salt, such leakage will show up on the salinity indicator as having contaminated the condensate.

To correct this difficulty it is first necessary to determine exactly where the leak is located. This can best be done by flooding the condenser up to the exhaust inlet connection. If the condenser is suspended from the turbine, it may be desirable to block up the condenser to eliminate this unusual weight from the turbine exhaust.

Once the condenser is flooded, water will run out of the tubes if they are ruptured within the condenser; and secondly, if the joint between the tube and the tube sheet is not tight, water will run out at this point. If the latter is the difficulty, tubes should be re-expanded, if they were originally put in by that method.

If the tubes were packed, the packing should be adjusted or possibly replaced until the leak is stopped. Leaky tubes should either be replaced or plugged up.

3. Turbine Gland Not Sealing Properly: This difficulty is corrected by adjusting the sealing pressure, or in extreme cases, examining the gland seals themselves to see if they have worn excessively.

4. General Air Leakage: The condensing system is designed to handle whatever air enters the condenser with the exhaust steam from the turbine, plus a normal amount of leakage from the turbine and other parts of the system under vacuum. General air leakage around valves, valve stems, gauge glasses, float control apparatus, flange gaskets, should be checked thoroughly in the event of any difficulties indicating loss of vacuum. It should be borne in mind that the vacuum extends back into the turbine and sometimes into the extraction heater at periods of light load in the event that such a heater is incorporated in the system. Air leakage should be promptly corrected as it increases the corrosion rate of the condenser tubes.

5. Insufficient Condensing Water: The quantity of circulating water should equal the quantity for which the condenser is rated, especially with warm, condensing water.

Formula for determining approximate G.P.M. circulated:

$$\text{G.P.M.} = \frac{(\text{lbs. steam condensed/hr}) \times 950}{(\text{Discharge Temp. °F.} - \text{Inlet Temp. °F.}) \times 500}$$

This may be determined by measuring the temperature rise in the circulating water passing through the condenser. At full shaft horse power the difference between the outlet condensing water temperature and the inlet temperature generally should not exceed 10°F. If the condensing water, in passing through the condenser, is heated more than this, the quantity of water is too low and the circulating water pump and piping should be checked to determine the cause of the deficiency in the condensing water system. Any obstruction such as foreign matter in the condenser tubes, or, should such refuse cover the strainer plate, there would be an increase in the pumping head on the circulating water pump and thus cut down the quantity of circulating water even though the pump may be in perfect operating condition.

Mr. Graham also suggests that the best way to avoid forced shutdown is periodic inspection and subsequent maintenance of all parts giving any suspicion of failure or otherwise indicating the need for repair.

Every seven days: Blow out air ejector strainer while units are in operation.

Every 30 days: Inspect all pump glands for leakage. If leakage is evident glands should be tightened to prevent air leakage and subsequent vacuum depreciation.

Every six months: Inspect and replace if necessary, zinc plates in the condenser water boxes.

Every 12 months: Inspect tubes of condensers for scale deposits and possible tube deterioration. Clean or replace tubes if this inspection warrants.

Thus all trouble should be avoided, and over a period of a year or more economies will certainly accrue from this system of applying "preventive medicine" rather than waiting for difficulty to occur.

Corrosion Resistant Alloys Available

Power plant operators are preparing for the future demands of industry and consumers by trying out improved condenser tube alloys to obtain longer life, prevent costly breakdowns and reduce maintenance expense.

Much progress has been made in corrosion research, as well as in field and service tests to determine the causes of condenser tube corrosion, and the influence of various factors on the corrosion rate of different alloys. Bridgeport has maintained a consistent program along these lines and has accumulated much valuable data over a period of many years. A great deal of this information is available through our Technical Service Department to operators.

A number of corrosion resistant condenser tube alloys are available which, if used under conditions for which they are best suited, will give longest service life and greatest economy. Arrangements may be made through our Technical Service Department to try out test lots of these alloys in order to determine which is best for the conditions involved. The properties of these alloys and their applications are described in Bridgeport's 112-page Condenser Tube Manual, full of practical information, specifications, corrosion research data and other valuable facts. A request on Company stationery will bring your copy promptly.

BRIDGEPORT BRASS

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Nine good reasons for

Modernizing with Westinghouse Gearmotors

on drives from 1 to 75 hp

1. FEWER PARTS TO WEAR
2. BPT "TOUGH-HARD" GEARS AND PINIONS
3. USE ALL WESTINGHOUSE MOTOR TYPES
4. HIGH EFFICIENCY
5. POSITIVE LUBRICATION
6. EASY ACCESSIBILITY
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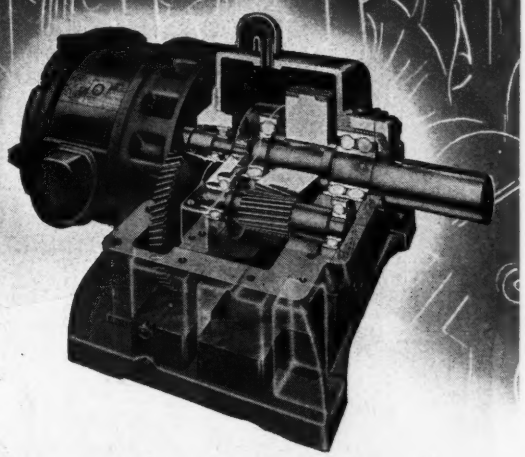
8. MOTOR AND GEARS BUILT BY ONE MANUFACTURER
9. DESIGNED AND APPLIED TO A.G.M.A. STANDARDS



There is a Westinghouse speed reduction unit for most applications
TYPE A GEARMOTOR—Single-reduction unit. Gear ratios: 1.22, 1.50, 1.84, 2.24, 2.73, 3.37, 4.17, 5.00, 6.25. Available with single-phase, polyphase, and direct current motors.
TYPE C GEARMOTOR—Double-reduction unit. Gear ratios: 7.61, 9.21, 11.3, 14.0, 17.5, 20.8, 25.7. Available with single-phase, polyphase, and direct current motors.
TYPE E GEARMOTOR—Double-reduction unit. Gear ratios: 31.2, 38.9, 47.3, 52.7, 58.3. Available with single-phase, polyphase, and direct current motors.

In the last few years, machine drives have taken a terrific peak-load punishment. So it's natural that reconversion will require many replacements with modern, economical drives.

When drives require speed reduction... and four out of five do...use a gearmotor. Specifying gearmotors simplifies ordering and delivery...saves installation expense because the complete drive is in one "package".

Westinghouse offers a complete line of gearmotors for speed-reduction drives up to 75 hp, and a complete line of similar speed reducing units for drives up to 1000 hp. Call your Westinghouse Office for information, or write Westinghouse Electric Corp., P. O. Box 868, Pittsburgh 30, Pa.

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★ *INDIRECT HYDRAULIC*

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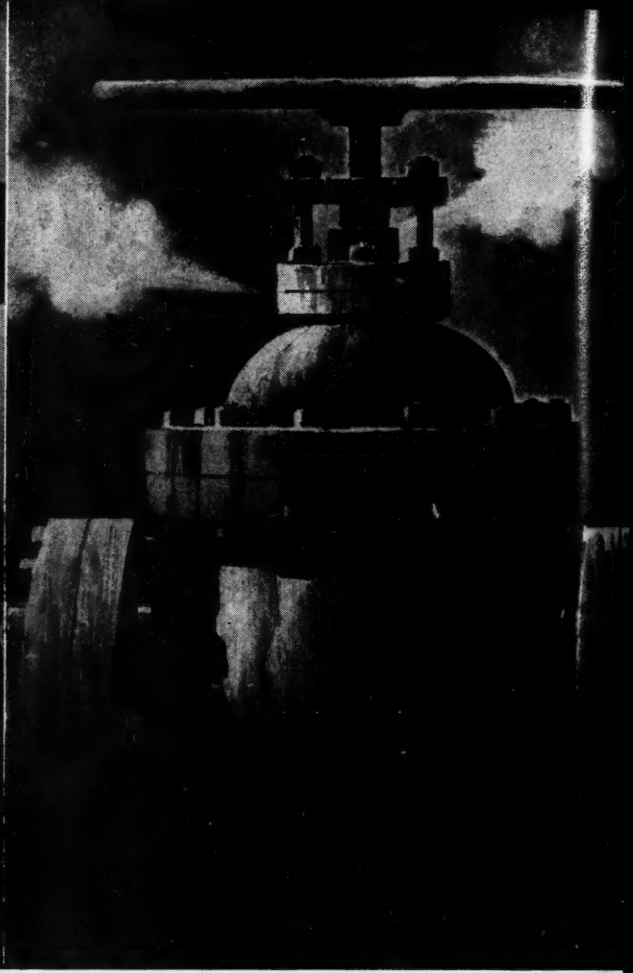

Industry's Jesse James . . . 1945

IN YOUR PLANT today you'll find a bandit that steals production efficiency and profits in true two-gun style.

Worn-out veteran valves – and others made prematurely old through the overload of war production schedules – can operate smoothly yet fail at critical process points, causing heavy loss of material. They may interrupt tight schedules when time-out for repair or replacement stalls production. Beyond economical repair, they may boost maintenance beyond reasonable limits.

Forestall Trouble!

The sensible thing of course, is to ferret out these valves *before they cause trouble,* and replace them with the valves that give you the most dependable operation, at the lowest maintenance cost in the long run . . . Jenkins Valves! The craftsmanship, quality of materials, and leadership of design that Jenkins builds into valves is your guarantee of this long life, and economical trouble-free operation. The only question is: *Which valves can I justify replacing?*

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Fortunately, Jenkins Engineers have worked out a plan, simple yet thoroughly proven-in-practice, whereby you can spot just such valves and justify their replacement on a simple score sheet of condition. Not an advertising promotion, but a sincere service offered by Jenkins to help on post-war problems. Jenkins Bros. "Valve Retirement Plan", now in operation in many plants, is proving valuable to management, maintenance engineers, superintendents, and operators. Free, no obligation. Send coupon for your company's plan today, to: JENKINS BROS., 80 White St., New York 13, N. Y.

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Please send me without charge or obligation, the JENKINS BROS. "VALVE RETIREMENT PLAN" with a set of valve record sheets.

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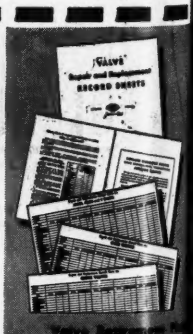

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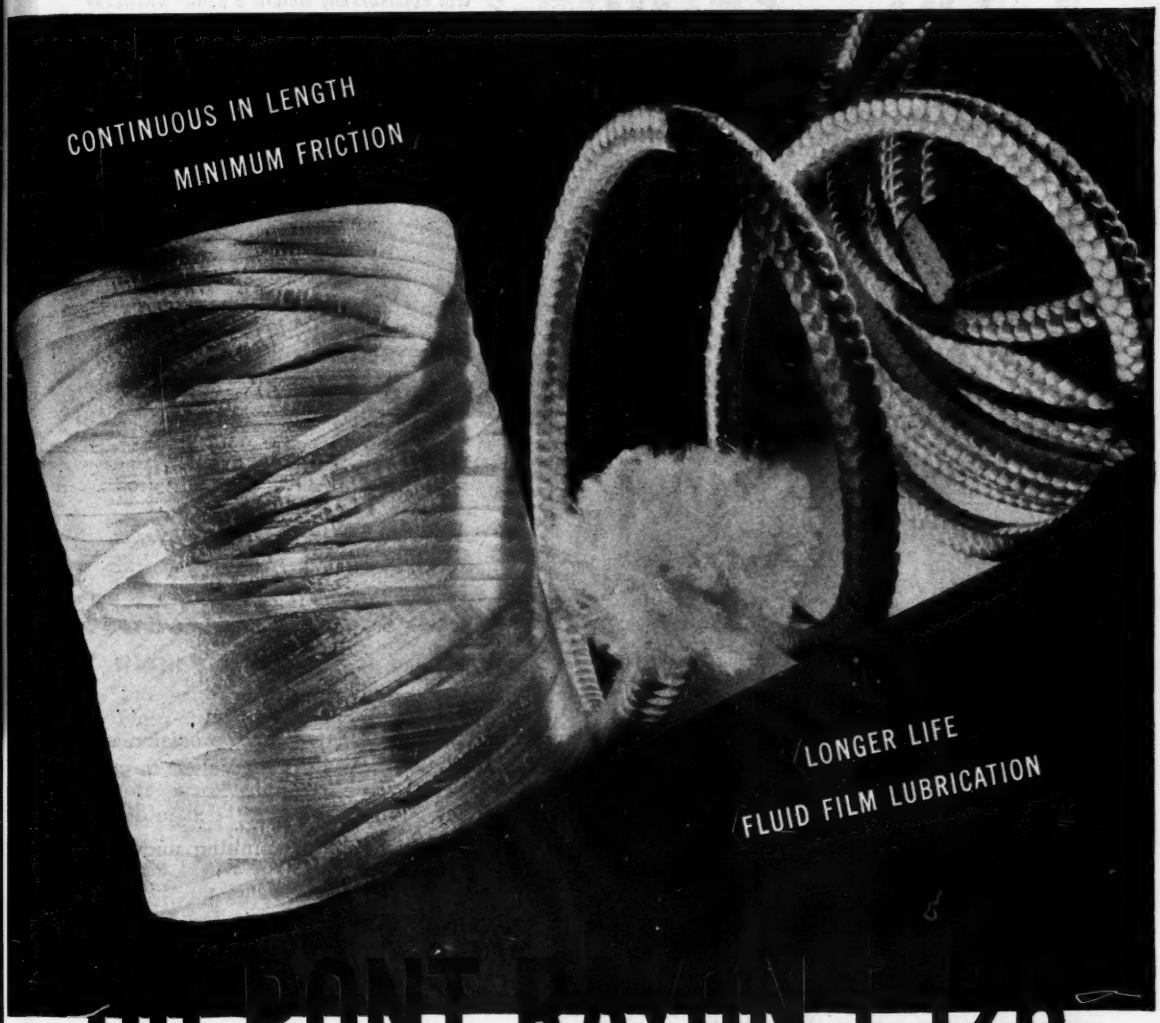

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the precision packing fiber

The strong growth of Rayon T 126 packing is "proof of the pudding." Working against hot or cold water and brine . . . on high or low pressures . . . this packing fiber shows these important points of superiority:

No exposed ends. Each fiber of Du Pont Rayon T 126 is continuous in length and precision smooth.

Uniform strength. No bulges. No low spots to allow excessive leakage.

No harshness. Smoothness and uniformity increase packing performance . . . minimize friction on moving metal parts.

Ideal lubrication. When wet, rayon assumes a wet-rawhide condition . . . provides a liquid film of lubrication.

With greater competitive production ahead, consider the advantages gained—the equipment wear and man-hours saved by Rayon T 126 packing. Ask your manufacturer or supplier for rayon packings, and use them as he recommends.

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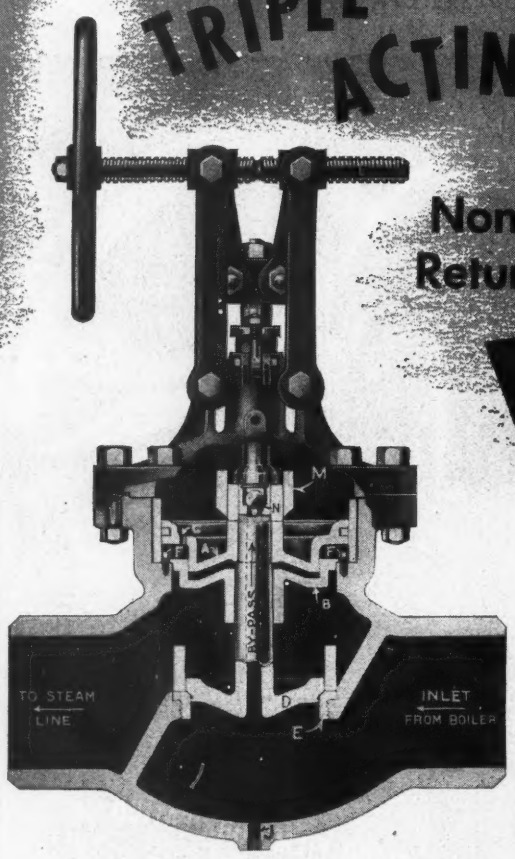
2 Will automatically isolate a boiler whenever its pressure, from any cause, is lower than line-header pressure.

3 Will prevent steam flow from boiler in event of sudden drop in line-header pressure below the boiler pressure.



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- All moving parts are in constant, perfect alignment.
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- Unfailing automatic operation for absolute safety.
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7 reasons....

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In comparison with other zeolite water softeners the Elgin delivers as much as 44% more soft water.

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Based on cost per thousand gallons of soft water delivered, the Elgin Water Softener is far lower in price.

3 LOWER OPERATING COST
By virtue of an improved distributing and collecting system, less regenerating salt and wash water are required.

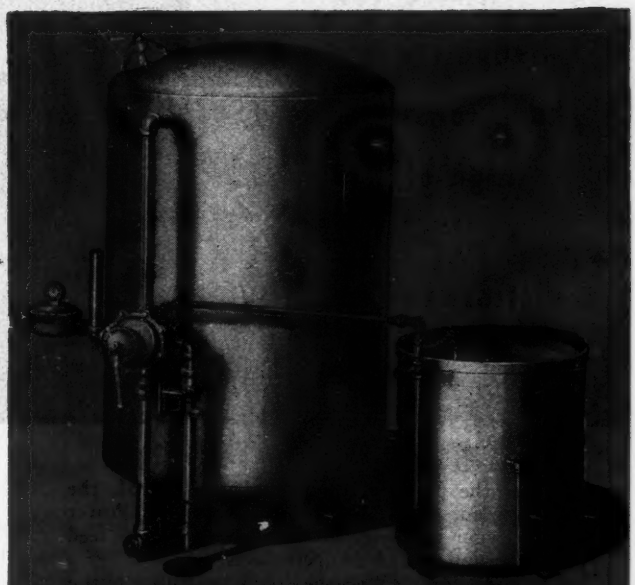
4 HIGHER EFFICIENCY
The water softening zeolite in the Elgin is kept clean and active so that equipment operates more efficiently without attention—and more "zero-soft" water is delivered per pound of salt used.

5 LESS MAINTENANCE
Unbiased surveys prove that with ELGIN quality construction throughout, fewer replacements are required. Loss of zeolite is prevented, thus eliminating costly additions.

6 LONGER LIFE
Efficient distribution, collection and regulation of water and brine add years to the life of Elgin Water Softeners.

7 LESS SPACE REQUIRED
To give the same capacity as an Elgin, other water softeners must be as much as 50% larger in size.

Existing water softeners of any make can be modernized by Elgin to provide the above features.



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THE ELGIN WATER SOFTENER gives greater capacity and higher efficiency because it accommodates a far greater quantity of water softening zeolite—and uses it more effectively by virtue of an ingenious manifold system and backwash regulator. Naturally, a greater volume of soft water is delivered because it's the zeolite that softens water—and more zeolite used with greater effectiveness means more softened water.

A NEW BULLETIN . . .
So important are these features to the users of soft water that we have prepared a new factual bulletin describing the construction and operation of the postwar Elgin Water Softener and explaining the benefits and economies of softened water. Ask for Bulletin 607. For hospitals it's Bulletin 608. For laundries it's Bulletin 609.

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Whether the pressure is 500 PSI or 5000 PSI, the Worthington Automatic VARIFLO Triplex Power Pump is your best selection for a high pressure feed pump for boilers and desuperheaters.

The photograph shows the easy accessibility of the stuffing boxes on top of the cylinder (an exclusive Worthington design), making routine attention easy . . . The first Worthington VARIFLO in service taken down after 12 months of continuous service, showed tool marks still evident on the stroke-changing elements. . . . The features listed below mean reduced operating costs, uninterrupted and continuous service.

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6. Pressure-lubricated drive shaft and stroke-changing elements are a self-contained assembly.
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Bulletin W-414-B50 on Worthington VARIFLO Power Pumps is "must" reading for all engineers interested in efficient boiler feed service. Write for it today. *Worthington Pump and Machinery Corporation, Harrison, N. J.*

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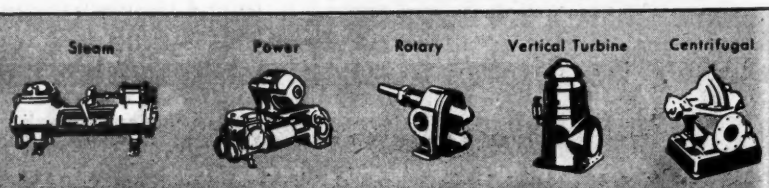
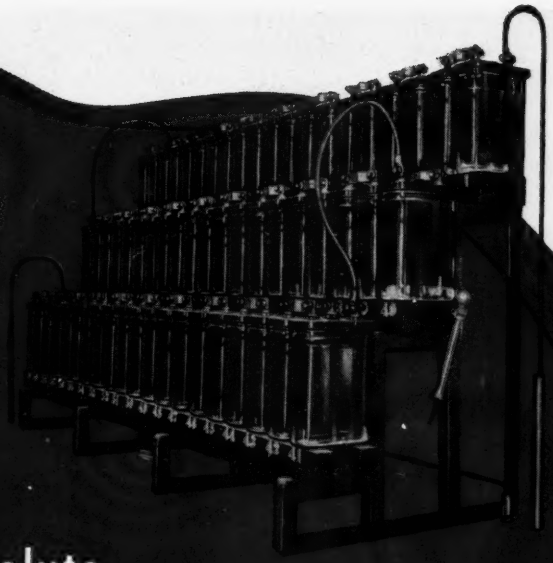
THE WORLD'S LARGEST MANUFACTURER OF PUMPS



PROBLEM:

To find insulated cable for battery-charging leads—immune to attack by electrolyte



SOLVED WITH FLAMENOL CABLE

An Ohio steel mill required insulated cable for its battery-charging equipment, which consisted of a 250-kw generator and a 27-panel switchboard. Cable was needed for leads from panels to batteries. As the leads ran underground, the cable insulation had to withstand moisture as well as electrolyte fumes and accidental contact with the electrolyte itself. Four years ago, at G.E.'s suggestion, Flamenol* Style FL insulated cable was selected for the job. The mill reports that the original installation is still giving trouble-free service.

RESISTS CHEMICALS—Flamenol Style FL cable is highly resistant to oils, water, mild acids, and alkalies—and weather. It is tough and stable, is flexible at low temperatures, and has high dielectric strength. Flamenol does not support combustion—therefore, prevents outages due to fires. Requiring no protective braid, it reduces the volume of wiring and eliminates terminating problems due to fraying. Its insulation strips easily and leaves the conductor surface untarnished.

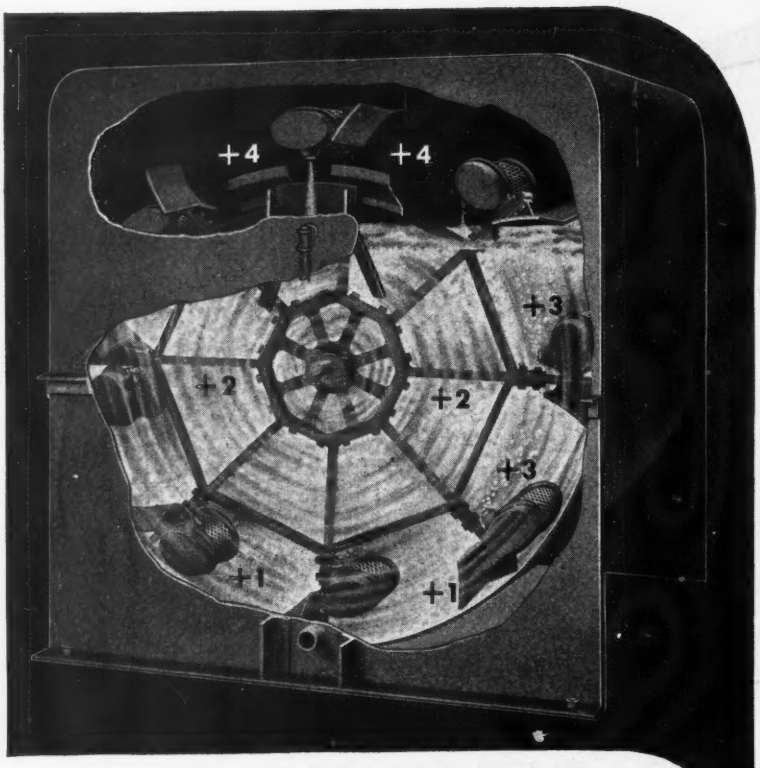
A G-E "FIRST"— Only G.E. makes Flamenol cable. Flamenol is the original cable insulated with plasticized polyvinyl chloride. G.E. introduced it in 1935—not as a substitute for rubber-insulated cable but as a new type possessing desirable properties not obtainable in rubber. To find out how Flamenol can help solve *your* problem—save you time, trouble, and expense—ask our local office, or write Apparatus Dept., General Electric Company, Schenectady 5, N. Y.

*Trade-mark reg. U.S. Pat. Off.

GENERAL ELECTRIC

502-54-1200

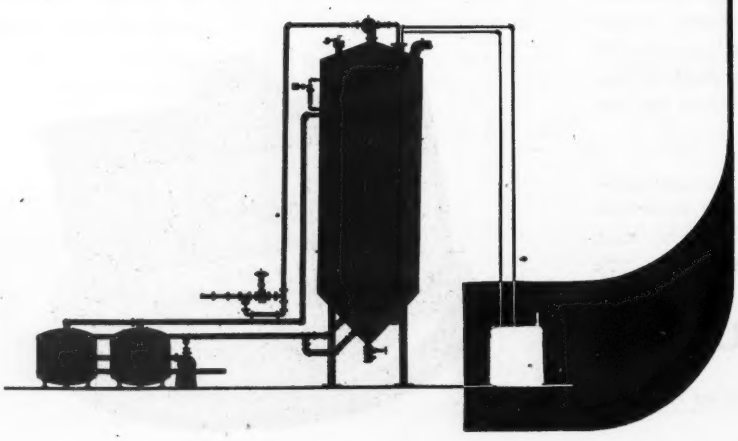
Keep on buying BONDS—*and keep all you buy*

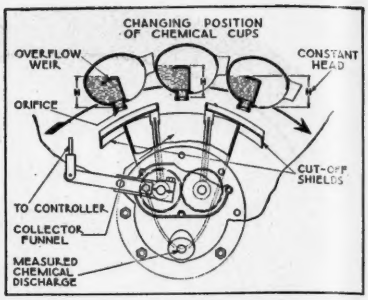


INFILCO CHEMICAL MIXER AND FEEDER

HOT-FLOW SOFTENERS

CONVERT WATER INTO BOILER FEED





A constant head over a constant orifice in any discharge position.

INFILCO Chemical Mixers and Feeders contribute greatly to the enviably successful operation of Hot-Flow Softeners.

Their function is to hold a chemical solution, or mixture, at a uniform strength—and, to feed it accurately.

They are doing just that—year after year—because of the cumulative effects of these plus value design features—

+1 The half-rounded bottom—with plow-shaped agitators sweeping close—eliminates dead spaces where any solids can deposit.

+2 Agitators—revolving vertically—circulate the mixture in a positive up and down motion. Stratification is impossible.

+3 As the cup moves down, trapped air escaping from its discharge orifice, blows out obstructions—keeping the orifice clean.

+4 Every chemical cup is designed to maintain a constant head over the orifice during the entire period of discharge.

And the cumulative results are—

+1 + +2 = ***Uniform Solution or Mixture.*** Samples, taken at random from the Mixer and Feeder, will never vary in chemical content more than 1½%.

+3 + +4 = ***Accurate Feeding.*** A constant head over a constant sized orifice is a precise means for feeding an unvarying volume of solution.

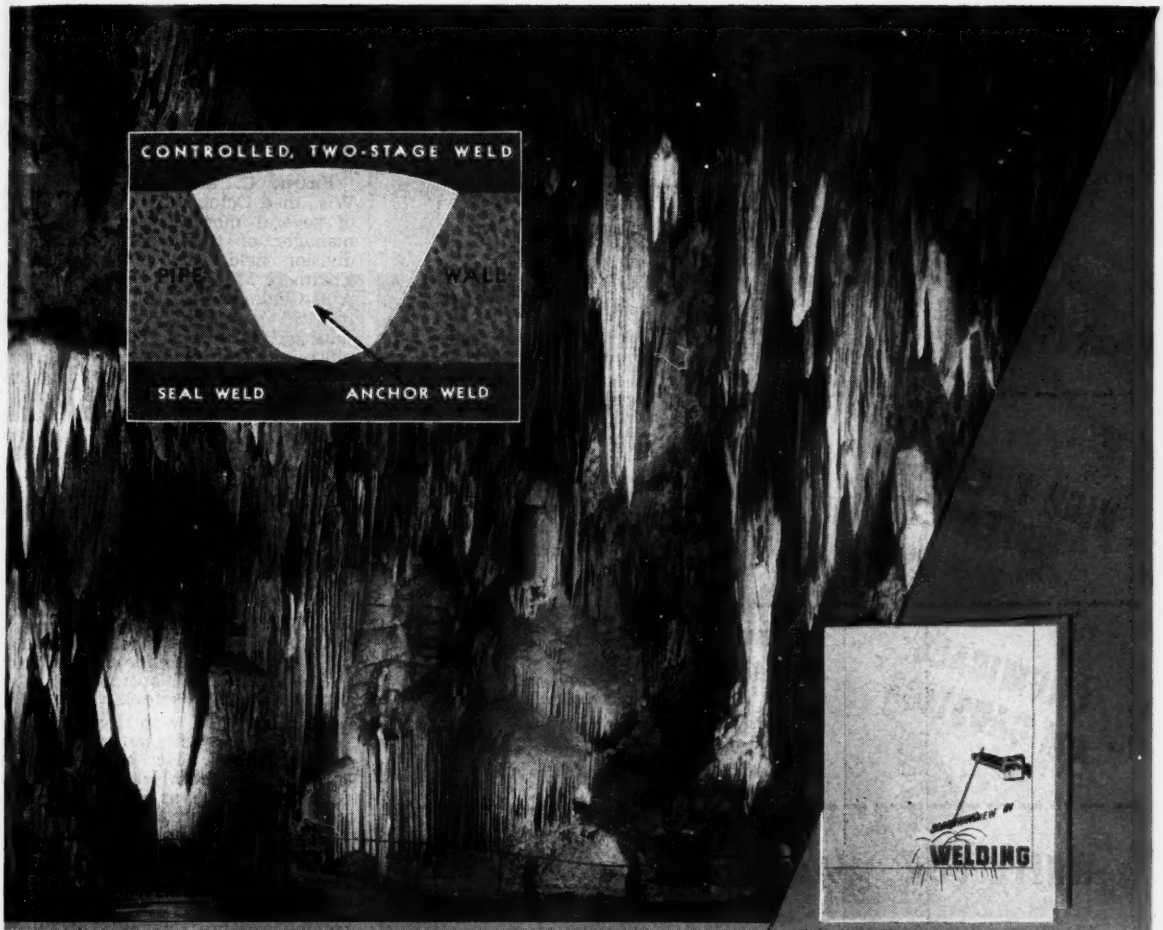
Not only the Infilco Mixer and Feeder, but also every other component part of the Hot-Flow Softener, has plus value features—every one of which contributes to smoother and more efficient operation. That's why Hot-Flow softening for boiler feed is hot process softening plus.

INFILCO

INFILCO

INCORPORATED

325 WEST 25TH PLACE, CHICAGO 16, ILL.



No Luray Cavern Look

TO BUTT WELDED JOINTS*

Stalactites and stalagmites are beautiful to see in an underground cavern but similar protrusions inside of fusion butt welded pipe joints have obvious dis-advantages. Icicles of metal can be eliminated by the use of backing rings, but these too have many dis-advantages. Westport Joints made by a patented method of Controlled, Two-Stage Welding assure "penetration without protrusion"; i.e. strength through the pipe wall to the root of the weld with a smooth contour at the base of the weld . . . Our bulletin "Something New in Welding" tells the complete story. Write for it today. And remember, while our shop pre-fabricated piping can be made with any type of joint, we believe you'll prefer and specify the Westport, after you read our bulletin.

*MADE WITHOUT BACKING RINGS BY THE MITCHELL-WESTPORT METHOD

WESTPORT JOINT

(PATENTED)

W. H. MITCHELL & CO., INC.

2142 ELLSWORTH STREET

PHILADELPHIA 46, PA.

SINCE 1899

FABRICATORS AND CONTRACTORS

MITCHELL

3 WAYS to save on your rod packing jobs . . .

For HOT OILS

CHESTERTON Parachute 600-HO

will hang on a long, long time because it is fully automatic, moulded in construction, requires no gland pressure to maintain a seal, holds friction to a minimum.

HIGH PRESSURE STEAM

CHESTERTON "64" Packing

has a distinctive diagonal asbestos ply construction that guarantees extra expansion and elasticity; no rubber cement to harden or burn out.

CHEMICALS and CAUSTICS

CHESTERTON Carson Brand Style 315

is made of long Canadian asbestos fiber with square braid that allows for maximum lubrication; ideal for centrifugal packing against acids, creosote, chemicals, caustics. . . .

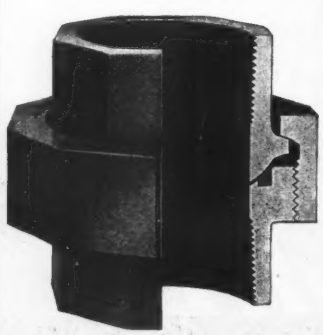
WRITE FOR *Free Packing Handbook*

New 72-page Catalog describes the complete line of Chesterton Mechanical Packings and Steam Specialties. Contains easy-to-use specification chart, conversion table for cutting ring packing and other useful engineering data. Handsomely illustrated with packing pictures and diagrams. For your free copy, simply write

A. W. CHESTERTON CO. • 64 INDIA ST. • BOSTON, MASS.

Distributors in Principal Cities

***Chesterton* Mechanical PACKINGS**



The Feature of the RECESSED BRASS SEAT in the

JEFFERSON UNION

makes it unique

It is cut from seamless drawn tubing—free from all casting defects—sound and uniform always! It cannot be dislodged by a pipe end screwed in too far.

JEFFERSON UNION CO.

601 West 26th St., New York 1, N. Y.

Factories at Lexington 73, Mass., and Lockport, N. Y.

Obituaries

Frank C. Angle

FRANK C. ANGLE, of Milwaukee, Wis., died October 25 after an illness of several months. Mr. Angle was manager of the general machinery division field sales offices of Allis-Chalmers Mfg. Co. Mr. Angle joined Allis-Chalmers in 1929 as a salesman in the Chicago office, and in 1934 joined the companies' San Francisco office and became manager of that office two years later, becoming Pacific Region Manager in 1943.

Mr. Angle was born at The Dalles, Oregon and received his B. S. degree from Oregon State College in 1923. He came to Allis-Chalmers after six years with the Elliot Co. Mr. Angle is survived by Mrs. Angle and two sons, James F. and Thomas G.

C. H. Wheeler

C. HAROLD WHEELER, JR., vice president and general manager of the C. H. Wheeler Manufacturing Co., of Pailadelphia, died November 24, after a month's illness, age 63.

Mr. Wheeler, who lived at the Drake Hotel, was a native of Staten Island, N. Y. He succeeded his father, the late C. H. Wheeler, who founded the firm, as general manager in 1923, pioneered many developments in the steam condenser industry, was employed by the Wheeler Condenser and Engineering Co. of Carteret, N. J. from 1897 to 1904 and joined his father's firm in 1905, becoming assistant manager in 1916.

Mr. Wheeler was a director of the National Bank of Germantown and Trust Co. and a member of the Pennsylvania Advisory Board of the American Mutual Liability Insurance Co., the American Society of Mechanical Engineers, the Union League and the Whitemarsh Valley Country Club.

He is survived by his wife, Dorothy Stewart; three sisters, Mrs. Paul Allen and Mrs. John Gay, of Philaledphia, and Mrs. Ada W. Haviland, of Northampton, Mass., and a brother, Leonard C. Wheeler, of Chicago.

MANUFACTURERS' *News*

Eagle-Picher and McArthur, Erwin Join Interests

ANNOUNCEMENT is made of the acquisition of a substantial interest in the common shares of McArthur, Irwin, Ltd., by Eagle-Picher Co. This stock purchase represents another forward step in the postwar expansion program of Eagle-Picher, and marks

"Trifles make perfection but perfection is no trifle"

One of a series of advertisements explaining how Kennedy gives careful attention to the details of valve design, construction and workmanship that provide maximum effectiveness, convenience, and length of service.

A "HANDY" HANDWHEEL

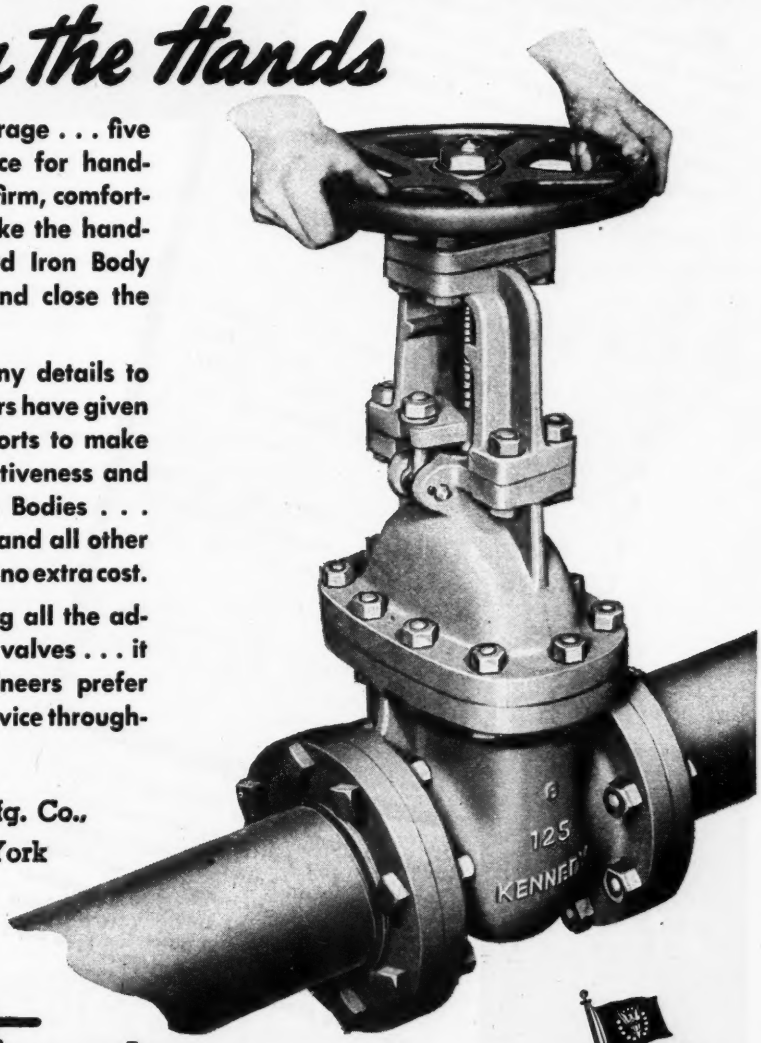
Easy on the Hands

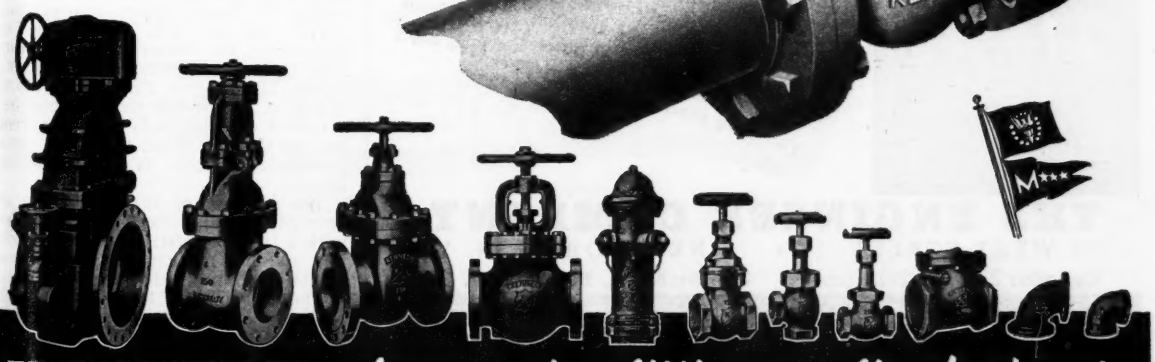
Extra large diameter for leverage . . . five spokes to provide extra space for hand-room . . . oval rim section for firm, comfortable grip . . . all help to make the handwheels on Kennedy Standard Iron Body Wedge Gate Valves open and close the valve easily and quickly.

This is just one of the many details to which Kennedy Valve designers have given thought and care in their efforts to make these valves superior in effectiveness and lastingly satisfactory service. Bodies . . . discs . . . seats . . . stems . . . and all other parts, too, have extra values at no extra cost.

Write for bulletin describing all the advantageous features of these valves . . . it explains why so many engineers prefer them for standard pressure service throughout their plants.

The Kennedy Valve Mfg. Co.
Elmira • New York



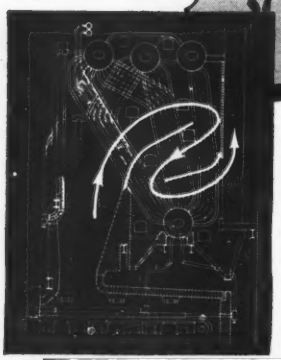


KENNEDY *valves . . . pipe fittings . . . fire hydrants*

How do YOUR BOILER BAFFLES compare with the best?

Modern methods of boiler baffling reduce flue-gas temperatures and draft losses—they increase boiler efficiency and overall economy of operation, often with marked savings in fuel. Check them against this list.

- Are the curves long and sweeping to provide smooth, rapid gas-flow across the tubes?
- Do they direct the flow of gases over practically every square foot of heating surface—without bottle-necks, dead-gas spaces or soot pockets?
- Are they gas-tight? Are means provided to keep them so in spite of tube expansion—and are they readily removable?
- Are they located where they are most effective or where they were easiest to install?



Unless you can answer "YES" to all these questions, you will profit by reading our new booklet on boiler baffles. It contains valuable information on baffle walls and illustrates numerous interesting applications to many types of boilers. It will help you save money—send for your free copy today.

THE ENGINEER COMPANY

75 WEST STREET • NEW YORK 6, N. Y.

Canada: F. J. Raskin, Inc. • 370 Rachel E., Montreal, P. Q.

Enco Streamline Baffles

PRODUCED EXCLUSIVELY BY THE ENGINEER COMPANY

the active interest of Eagle-Picher in the lead business of Canada.

Each of these firms is over 100 years old. In 1842 a painting and decorating business was established in Montreal, Canada, in a small store building where the Imperial Bank of Canada now stands.

A year later, and 816 miles south of Montreal, the present Eagle-Picher Co. was founded in Cincinnati to manufacture white lead also.

Plans are being formulated now for the expansion of McArthur, Irwin, Ltd., into the manufacturing and marketing of litharge and red lead besides increasing the company's present white lead business.

In the past four years, Eagle-Picher has acquired holdings of other nonferrous metals companies in Kansas City, Dallas and Cleveland. In addition, extensive mining properties have been recently opened in Arizona, Nevada and in Taxco, Mexico.

Westinghouse to Have Meadville Plant

WESTINGHOUSE ELECTRIC CORP., Pittsburgh, Pa., announced it would purchase property and buildings in Meadville, Pa., for the production of industrial heating equipment. The property, comprising more than five acres of land and five major buildings with more than 100,000 ft of floor space, is being purchased from Talon, Inc.

The entire Westinghouse line of industrial heating equipment will be produced in the Meadville plant. This includes many types of furnaces and other devices for heat-treating, driers, immersion heaters, space heaters and thermostats.

Westinghouse will employ from 150 to 200 persons in this new production unit, it was stated.

Post-War Production of G.E. Turbine-Generators to Double

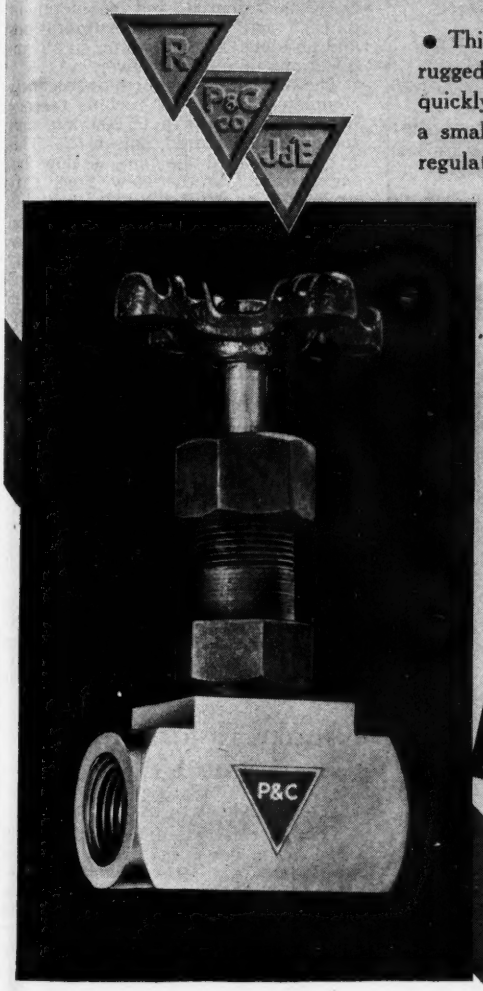
PRODUCTION OF steam turbines, source of two-thirds of the nation's electric power, is expected to be doubled in post-war years by the General Electric Co., in comparison with the pre-war average.

The company has a backlog of over $30,000,000 in turbine-generator orders, covering both new installations and replacements of obsolete machines. Full-scale peace-time production is expected to be reached by December in the General Electric turbine factories at Schenectady, N. Y., Lynn, Mass., and Fitchburg, Mass. Many of the orders were placed before V-J day, but only recently went into production when materials were released by the War Production Board.

The backlog of turbine orders at present includes over 40 machines with a total capacity in excess of one and one-half million kilowatts. Some of the machines will be new models.

The possibilities of atomic power replacing present generating equipment, such as steam turbines, in central power stations, railroads, or other businesses in which the generation or use of power is of extreme importance, were recently discussed

A *Tough* LITTLE VALVE OF ALL WORK

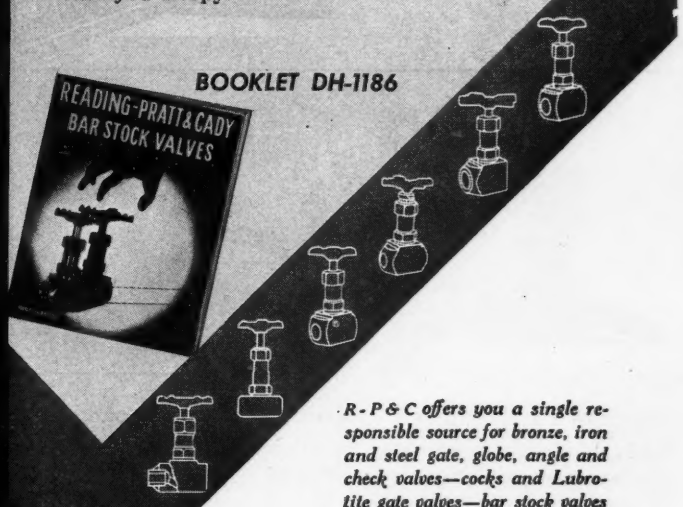


• This line of "bar stock" valves was developed by R-P&C as rugged, economical, close control valves. But experience in service quickly demonstrated their usefulness practically anywhere that a small, tough valve is needed for either close control, normal regulation or shut-off. Their service, pressure and temperature ratings extend over a wide range.

R-P&C bar stock valves are in stock in globe and angle types, made of bronze, carbon steel, 12-14% stainless steel, combination carbon steel and 12-14% stainless steel and in 18 and 8 stainless steel—in sizes up to 1".

Let us give you complete information about R-P&C bar stock valves. It is contained in a file size booklet—DH-1186. We will be glad to send you a copy.

BOOKLET DH-1186



R-P&C offers you a single responsible source for bronze, iron and steel gate, globe, angle and check valves—cocks and Lubrotite gate valves—bar stock valves—cast steel fittings—D'Este Automatic Regulating Valves.

READING-PRATT & CADY

MANUFACTURERS OF
READING CAST STEEL VALVES AND FITTINGS • PRATT & CADY BRASS AND IRON VALVES
D'ESTE AUTOMATIC REGULATING VALVES

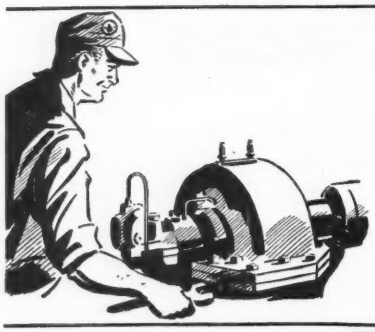
ACCO

Reading, Pa. • Atlanta • Chicago • Denver • Detroit • Houston • Los Angeles • New York • Philadelphia • Pittsburgh • San Francisco • Bridgeport, Conn.

READING-PRATT & CADY DIVISION
AMERICAN CHAIN & CABLE

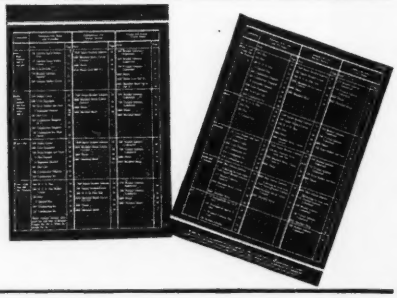
TRADE MARK

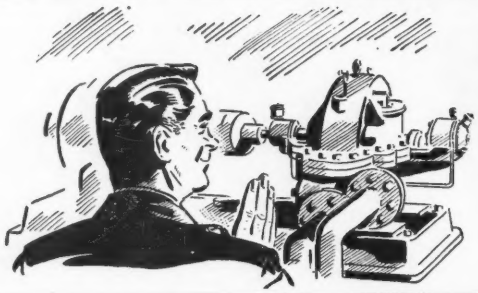
3 STEPS TO FEWER PACKING REPLACEMENTS



1. Make up your mind to put an end to power-wasting leaks and frequent time-wasting replacements.

2. Ask the Belmont distributor to show you the handy PACKING RECOMMENDATION CHARTS.





3. Standardize on the right Belmont packing at every point.

Belmont Distributors are located in every large industrial center, ready to serve you promptly from local stocks. Get the **PACKING RECOMMENDATION CHARTS** from the one nearest you — or send the coupon to us.

THE BELMONT PACKING & RUBBER CO. — BELMONT — PHILADELPHIA, U.S.A.

on the blue-and-orange box

THE BELMONT PACKING AND RUBBER COMPANY
Butler & Sepviva Streets, Philadelphia 37, Pa.

Gentlemen: Please send PACKING RECOMMENDATION CHARTS for the services checked:

☐Steam . . . ☐Hot Water . . . ☐Cold Water . . . ☐Brine . . . ☐Ammonia . . .
☐ Acids & Caustics . . . ☐ Air . . . ☐ Gas . . . ☐ Oil . . . ☐ Gasoline . . .
☐ Asphaltic & Tar Products . . .

Name .....
Company .....
Address .....

by Harry A. Winne, vice president in charge of G-E engineering policies, and Dr. C. G. Suits, vice president and director of the Research Laboratory.

"Were we responsible for conducting the affairs of such organizations," they said, "we should go right ahead with our plans for the years to come on the basis of present day commercially available sources of energy; namely, coal, oil, and water power. Only as research and development proceed shall we learn the limitations and possible practical commercial applications of nuclear power."

The turbine-generator most recently completed at the G-E turbine factory in Schenectady is a 65,000 kw unit for the Consolidated Edison Co. This hydrogen-cooled machine is now being installed in the New York City area.

During the four war years General Electric's turbine production was nine times the average pre-war yearly production. Factories were operated at Erie, Pa., and Syracuse, N. Y., in addition to the plants at Schenectady, Lynn, and Fitchburg.

Fairbanks-Morse Appoints New Distributors

THE SEATTLE BRANCH of Fairbanks-Morse & Co. has announced that the Milwaukee Machinery Co. of Portland, Ore., has been appointed exclusive distributor for the complete line of Fairbanks-Morse turbine pumps, including the Fairbanks-Morse Pomona pump and the Fairbanks-Morse oil lubricated turbine pump.

Cascade Machinery Co. of Seattle, Wash., will handle all Fairbanks-Morse pumping equipment. This firm will also act as distributors for Fairbanks-Morse motors and electrical equipment.

Brooks Rotameter Co. Formed

STEPHEN A. BROOKS and seven associates, each with extensive experience in rotameter manufacture and application, have organized the Brooks Rotameter Co., a corporation capitalized at $100,000.00. A factory has been acquired at Lansdale, Pa., and manufacturing has been started upon all types of rotameters for flow rate measurement and control.

Brooks is a graduate chemical engineer with a wide experience in chemical manufacture and instrumentation. For the past six years he has been Vice President of Fischer & Porter Co., in charge of sales and advertising. The eight men founding this new company have all had years of experience in rotameter engineering. The exact address of the company is the Brooks Rotameter Co., Box B-2011, Lansdale, Pa.

Harry H. Long will be chief fluids engineer in charge of specifications and calibrations. He will be assisted by James Anthony and Joseph Ducsik, who have had many years' experience in specifying and calibrating rotameters. Garbutt W. Aiman will have charge of precision rotameter tube manufacture. Jack Bradley will manage production and Lou Rosenblum will handle purchasing and accounting.

GRINNELL *for*

PIPE PREFABRICATION

Complete facilities for the fabrication of every type of piping . . . protested before delivery.

PIPE SUSPENSION

Constant-Support Hangers for constant support of piping in all "hot" and "cold" positions . . . full safety factor of the supported system always maintained . . . individually calibrated . . . minimum headroom required.

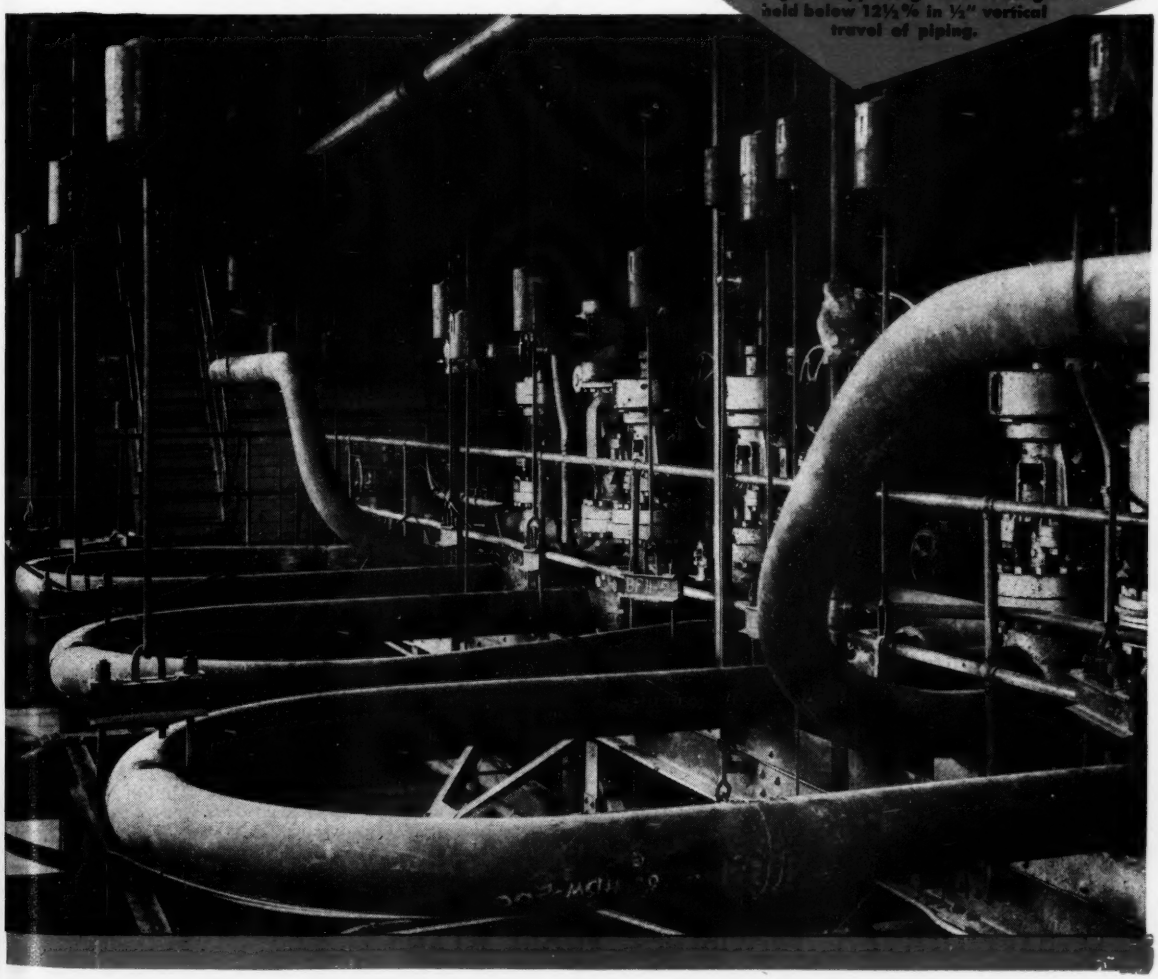
Engineered Spring Hangers . . . stock hangers for loads ranging from 84 lbs. to 4700 lbs. Change in supporting force of hanger held below 12½% in ½" vertical travel of piping.

Years of experience in interpreting piping requirements, strategically located pipe fabricating plants, and the most complete line of pipe hangers . . . these are the reasons why Grinnell supplies piping and hangers exactly suited to the individual layout. GRINNELL COMPANY, INC. Executive Offices, Providence 1, R. I. Branch Warehouses in principal cities. Pipe Fabrication Plants: Providence, R. I., Atlanta, Ga., Warren, Ohio.

GRINNELL

FOUNDED 1850

WHENEVER PIPING IS INVOLVED



Darts don't delay

When you need a Union

Pronto!

Bronze to Bronze Ball Joint

Seating Permits Instant Uncoupling

Because Darts seat perfectly—without ruinous wrenching—they may be uncoupled instantly as often as needed in other locations. Bodies and nuts—made of high-test air-refined malleable iron—are practically unbreakable.

Ask your supplier to send Darts—the most economical in length of service.

DART UNIONS

DART UNIONS LIVE LONGER

E. M. DART MFG. CO., PROVIDENCE, RHODE ISLAND

This company will specialize in rotameter flow rate measuring instruments designed to meet the difficult services and corrosive atmospheres encountered in the process industries.

Robins Conveyors Inc., Passaic, N. J., has announced the opening of new offices in the Brown-Marx building, First Ave. and 20th St. in Birmingham, Ala. These offices are under the direction of Charles A. Thompson, who served the company before the war as a sales engineer in the Pittsburgh office. C. B. Davis, the company's Birmingham agent since 1916, has retired from business and is moving to Florida.

MANUFACTURERS' *Personals*

Arthur R. Tofte has been named manager of the advertising and public relations department, Allis-Chalmers Mfg. Co. Tofte has been a member of the department since 1938. He succeeds George J. Callos, who resigned to become vice president and account executive for Klau-VanPieterson-Dunlap Associates, Inc., Milwaukee advertising agency.

Grant B. Shipley, chairman of the board of Elliott Co., Jeannette, Pa., announces that at a meeting of the Board of Directors, W. A. Elliott was elected president. Mr. Elliott has been executive vice president. Mr. Shipley, who remains as chairman of the board, previously was also president. F. H. Stohr, formerly assistant to the president, was elected executive vice president and F. W. Dohring, who has been general sales manager, was elected vice president in charge of sales. Other executive officers of Elliott Co. include: R. W. Owens, vice president in charge of manufacturing, R. B. Smith, vice president in charge of engineering, Dundas Peacock, controller, and M. G. Shevchik, secretary and treasurer.

Hewitt Rubber Corp. has announced that the P. J. O'Donnell Co., Inc., has been appointed Boston distributor and will handle sales of industrial rubber products throughout eastern Mass.

J. H. Heintz, sales and construction engineer who has been prominently identified with the construction industry for the past 25 years, has been appointed general sales manager of the C. S. Johnson Co., manufacturers of construction machinery and equipment at Champaign, Ill. Before joining the C. S. Johnson Co., M. Heintz was engaged in airport construction in Florida and Central America from 1941 to 1944.

Election of David F. Austin as sales vice president, United States Steel Corp. of Delaware, has been announced Mr. Austin has been acting vice president since June 20, 1945, during which time he continued as vice president in charge of sales, Carnegie-Illinois Steel Corp.

Election of Robert B. McColl as executive vice-president of American

There's a POWELL VALVE for every Power Plant service.

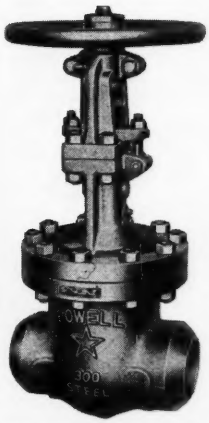
To meet the requirements of every kind of service in the all-important field of power, Powell has developed a complete line of Bronze and Iron Valves of every type and pressure required to control media at the lower temperatures; all types of Steel Valves for higher temperatures—in pressure classes from 150 to 2500 pounds; and an outstanding line of Cast Steel Non-return Valves designed and engineered to afford positive protection for boiler installations.

That is why power plants throughout the United States, including many of the largest utilities, have standardized on Powell Valves.

The Wm. Powell Co., Cincinnati 22, Ohio

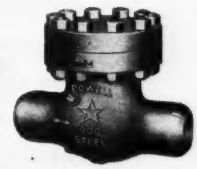
DISTRIBUTORS AND STOCKS IN ALL PRINCIPAL CITIES

125-pound Iron Body, Bronze Mounted or All Iron O. S. & Y. Gate Valve.

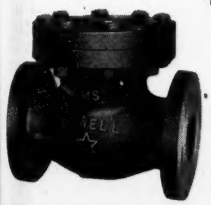


Class 300-pound Cast Steel Welding End O. S. & Y. Gate Valve. Powell Cast Steel Valves are available in pressure classes from 150 to 2500 pounds, inclusive.

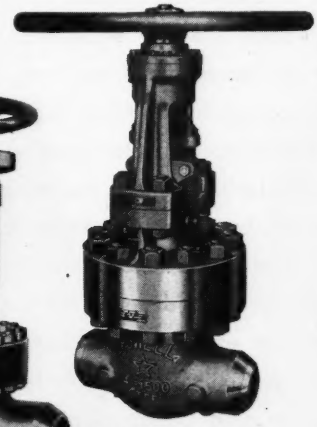
200-pound Bronze Globe Valve with regrindable, renewable seat and disc.



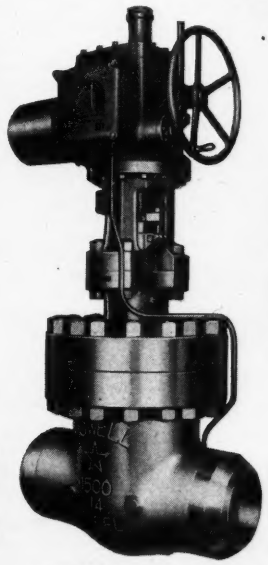
Class 900-pound Cast Steel Welding End Swing Check Valve.



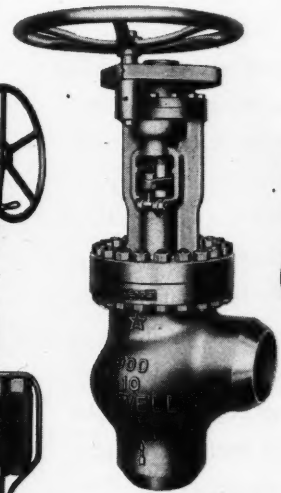
250-pound Iron Body Bronze Mounted Regrinding Swing Check Valve.



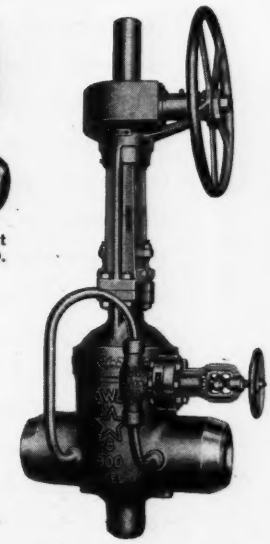
Class 1500-pound Cast Steel Welding End O. S. & Y. Gate Valve.



Class 1500-pound, 14" Welding End Cast Steel Gate Valve, with top-mounted Limitorque Motor Operator.

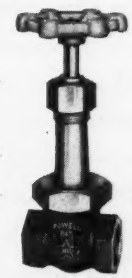


Class 900-pound Cast Steel, Non-return Angle Valve, spur gear operated. Powell Non-return Valves are provided with spur gear, bevel gear or toggle operation. Motor operators can also be provided, if desirable.



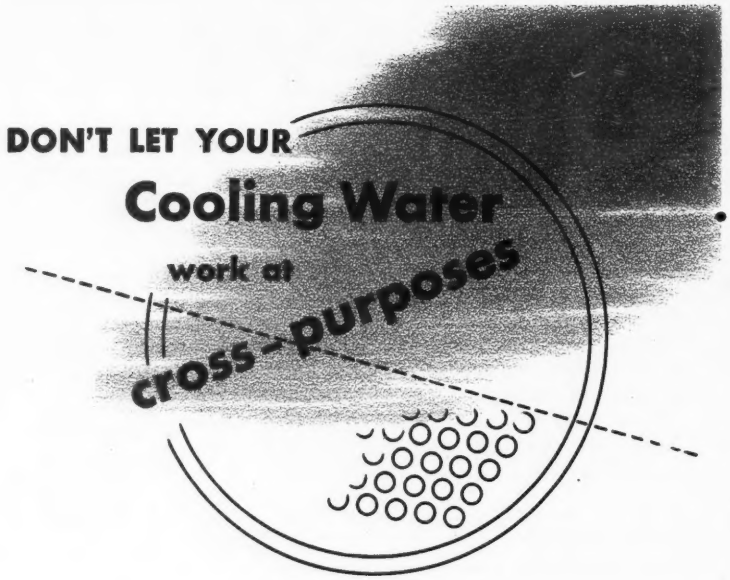
Class 900-pound Cast Steel, gear operated Gate Valve with welded bonnet, special by-pass and sediment and inspection cap.

125-pound Iron Body Bronze Mounted or All Iron O. S. & Y. Globe Valve.



200-pound Bronze Gate Valve with renewable disc.

POWELL VALVES



Cooling water nearly always contains micro-organisms that threaten to defeat its cooling power. These organisms are the "slime-formers" that multiply at warm temperatures and form mucilaginous films on the water-side surfaces of condensers.

Particles of inorganic matter become imbedded in the slime, producing a tough, insulating coating that greatly retards heat transfer, often to such an extent that condensers cannot function at rated capacity

To clean out such deposits by any mechanical means requires expensive shutdowns *periodically*, for the slime immediately begins to accumulate again after every cleaning. Chlorination, however, destroys slime growths already present, and prevents recurrence by killing the slime-forming organisms in the water supply, so that water-side surfaces of condensers remain clean month in and month out.

Every cooling water system requires individual treatment to assure satisfactory slime control at minimum expense. W&T engineers will gladly make a survey and recommend the method of chlorine application best adapted to the particular needs of your plant.

WALLACE & TIERNAN PRODUCTS, INC.

Manufacturers of Chlorine and Ammonia Control Apparatus

Belleville 9, N. J. • Represented in Principal Cities

CD-21S

Locomotive Co. has been announced. Mr. McColl is succeeded as vice-president in charge of manufacturing by W. L. Lentz, of Schenectady, who directed the company's vast tank and locomotive manufacturing program there the past five years.

Roy A. Bass has recently been appointed director of distribution of Dresser Industries, Inc., Cleveland, Ohio, a new post. He will be responsible for the national program of Dresser and its member companies in the establishment and expansion of distribution in industrial centers. Before assuming his present duties, he was Buffalo district sales manager for Ross Heater & Mfg. Co., Inc., Buffalo, N. Y., with whom he has been connected for the past 11 years.

George F. Goodyear, Buffalo patent attorney, has joined the executive staff of Hewitt Rubber Corp., where he is assuming the responsibility of assistant secretary. Goodyear will head the legal department of Hewitt and its subsidiary company, Robins Conveyors, Inc., of Passaic, N. J.

Thomas J. Hilliard has been elected vice president in charge of sales of Carnegie-Illinois Steel Corp. Mr. Hilliard has been general manager of sales since 1938. He will be succeeded by J. Douglas Darby, who has been manager of sales for the company in Philadelphia since 1939. Two other sales department staff changes announced are A. Paul Selby as assistant general manager of sales and Wesley C. Bobbitt as manager of sales in Philadelphia.

Hewitt Rubber Corp. has named Adrian W. Smith as manager of the Restfoam Division. For the past five years Mr. Smith was executive assistant to Burdette S. Wright, Vice President and General Manager of Curtiss-Wright Corporation's Airplane Division. Previously he was Vice President of Dexter P. Rumsey & Co., Buffalo. In 1934 he served as President of the Buffalo Real Estate Board.

Equipment Supply Co., 60 Richards Street, Salt Lake City, Utah, has recently been appointed a franchised distributor of Briggs Clarifier Co. of Washington, D. C. The firm will serve as distributor for the company's industrial oil filtration products in the State of Utah; Unita County, Wyoming; the Southern half of Idaho and a portion of Eastern Nevada.

G. V. Woody has been appointed by the Allis-Chalmers Mfg. Co. of Milwaukee, Wis., to succeed R. C. Newhouse as manager of the basic industries department. He has been manager of the company's district office at Pittsburgh since 1934, although in 1941 and 1942 he served as administrator of the company's priorities management organization in Milwaukee. Mr. Newhouse, who will be retained as consulting engineer, retires after more than 40 years of world-wide service as engineer, inventor and designer of some of the largest cement and milling machinery.

Allen-Bradley Co. has recently appointed Charles B. Pickering, former-

1,250,000
Pounds of Steam Per Hour
FOR PHILLIPS PETROLEUM CO.'S BORGER, TEXAS
BUTADIENE PLANT

Five Vogt Class VR Steam Generators

provide 1,250,000 pounds of steam each hour for the production of butadiene, so vital to America's synthetic rubber program. The steam is used directly in process and for prime mover power with exhausts for process purposes.

Photo courtesy Phillips Petroleum Co.

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covering important oil and gas fired installations. Write on your letterhead.

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HENSZEY

BOILER FEED REGULATORS

provide CONTINUOUS, AUTOMATIC boiler water level control

HOLDS WATER LEVELS TO CLOSE LIMITS

The Henszey Regulator is extremely sensitive — there is less lag. Responds quickly — avoids the hazards of high as well as low water levels.

METALLIC EXPANSION

The Henszey Regulator works on the positive metallic expansion principle — no small tubes to spring leaks.

NO STRUCTURAL SUPPORTS

The Henszey Regulator goes right in the line — needs no supporting members — easy to install.

POSITIVE VALVE

The Henszey Regulator uses a special valve made expressly for this instrument by a prominent valve maker.

LESS SPACE REQUIREMENT

The Henszey Regulator can be installed in cramped places using up very little space.

Send for bulletin

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Dept. C-12, Watertown, Wis.

HENSZEY

BOILER FEED REGULATORS

Continuous Blowdown • Distillation Systems • Heat Exchangers
Feed Water Meters • Flow Indicators • Proportioning Valves

ly industrial application engineer in Connecticut for five years, as sales engineer connected with its Boston office. Mr. Pickering is a graduate of Tufts College in electrical engineering. He will serve the New England territory as application engineer for Allen-Bradley solenoid motor controls.

J. A. Armstrong has recently been appointed as district manager of the Syntron Co., Homer City, Pa. He will be engaged in sales and engineering service on the company's line of vibratory material handling equipment for the State of Michigan, with the exception of the Detroit metropolitan area. His headquarters will be in Lansing, Mich. He will also supervise the sale of the company's portable electric tools and self-contained, gasoline hammers in the same area.

Marcus M. Chapman has recently been appointed manager of sales, sheet division, of the Carnegie-Illinois Steel Corp. and succeeds Howard V. Clark, who has recently resigned from this U. S. Steel subsidiary. Mr. Clark is a native of Vandergrift, Pa., and a graduate of Bucknell University. He has been associated with the U. S. Steel subsidiaries since 1919 when he started work as an open hearth employee.

The American Locomotive Co. has recently appointed Carl J. Dinic to be executive assistant to the president of the Company, D. W. Fraser. Mr. Dinic has been associated with the Company since July 1943 and prior to that was with the United States Steel Corp. of Delaware with offices in Pittsburgh. He has also been associated with the Eastern Gas & Fuel Associates of Boston.

Iron Fireman Manufacturing Co. has appointed Howard M. Cutshaw assistant sales manager, and Thomas A. Marsh, manager of corporation sales. Cutshaw, who has been Iron Fireman's central division manager for several years, will make his headquarters in Cleveland. One of the company's pioneer members, he first entered the organization as a district representative in 1928. His work will center on the expansion of the dealer organization. Marsh has been the company's national industrial engineer since 1934 and will retain this post in addition to his duties as corporation sales manager. He succeeds Karl Saboe, who was recently transferred to St. Louis as branch manager.

The Motor Division of General Electric's Apparatus Department has been reorganized into four Divisions and one section. W. H. Henry, formerly manager of the Motor Division, is appointed assistant manager of the Industrial Divisions in charge of the motor business. The following Division managers have been appointed: A. W. Bartling, Elliott Harrington, J. T. Farrell and P. A. McTerney. E. A. Green returns from war manufacturing assignments to the motor organization as general assistant to Mr. Henry. D. E. Moorhead is appointed assistant to Mr. Henry. O. F. Vea continues in charge of the motor

GLOBE STEEL TUBES

what's your need in SIZE?

Globe supplies seamless and welded stainless steel tubing ranging from an outside diameter less than that of an average lead pencil — ⅛ inch — up to 6 inch outside diameter (Iron Pipe Size).

Thick-walled, seamless pressure tubes in carbon and alloy steels from ½ inch up to 6⅝ inch outside diameter for huge boilers in utility and industrial power plants are supplied by Globe, as well.

Your tubing needs may lie somewhere between these two extremes — whatever your requirements, standard or special in a wide range of sizes, shapes, and analyses, Globe is qualified by experience and facilities to supply you with tubing of the quality and uniformity you demand.

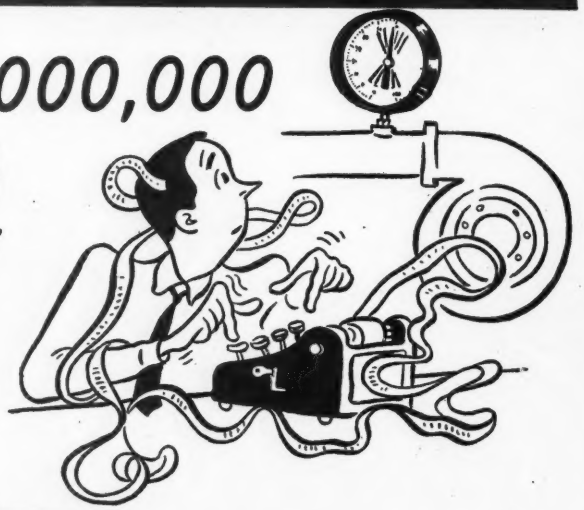
GLOBE STEEL TUBES CO., Milwaukee 4, Wisconsin

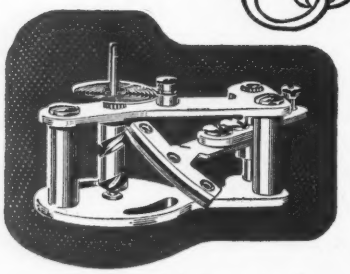
GLOBE TUBES

★ STAINLESS STEEL TUBES ★ PRESSURE TUBES ★ GLOBEIRON TUBING ★ GLOWELD TUBES
★ CONDENSER AND HEAT EXCHANGER TUBES ★ MECHANICAL TUBING

5025

75,000,000 IS A LOT





The highly polished contact surfaces of the graphited Bakelite cam and the bronze helicoid roller account for the unusual wearing qualities of the Helicoid movement.

75 million is a lot of anything. And when any pressure gage withstands 75 million cycles of operation, that represents a lot of gage service.

To determine how much longer Helicoid Gages with Helicoid movements would wear than ordinary gages with spur geared movements, an endurance test was run by an independent testing laboratory.* Two of the best spur-geared movement gages were tested against Helicoid Gages.

All gages were pulsated at the rate of 1200 cycles per minute. One gage failed after 500,000 cycles because the stainless steel teeth were worn away. The other gage failed after 10,000,000 cycles. After 75,000,000 cycles (as of Sept. 5, 1945), the two Helicoid Gages were still operating, and were within an accuracy of ½% and 1% respectively.

This proves that the Helicoid movement greatly outwears spur geared movements and that Helicoid Gages remain accurate long after ordinary gages are worn out.

If your service cost on pressure gages is high, it will pay to switch to Helicoid Gages.†

*U. S. Testing Co., Inc., Hoboken, N. J. See report 42592.

†Formerly called "Certified."

ACCO

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HELICOID GAGE DIVISION
AMERICAN CHAIN & CABLE

TRADE MARK

marketing and promotion section, and A. A. Merrill in charge of forecasting, order budgets and statistics group for all motor lines.

R. F. Van Alstyne, 306 Fairmont St., Davenport, Iowa, has been appointed representative of American Engineering Co., Philadelphia, for the sale of Taylor and Perfect Spread Stokers. His territory includes Des Moines and the eastern half of Iowa, as well as the Tri-cities. Mr. Van Alstyne was associated for a number of years with the Whiting Corp. and more recently, the Midland Refractories Corp.

NEWS *from* THE FIELD

New Specifications and Testing Procedures

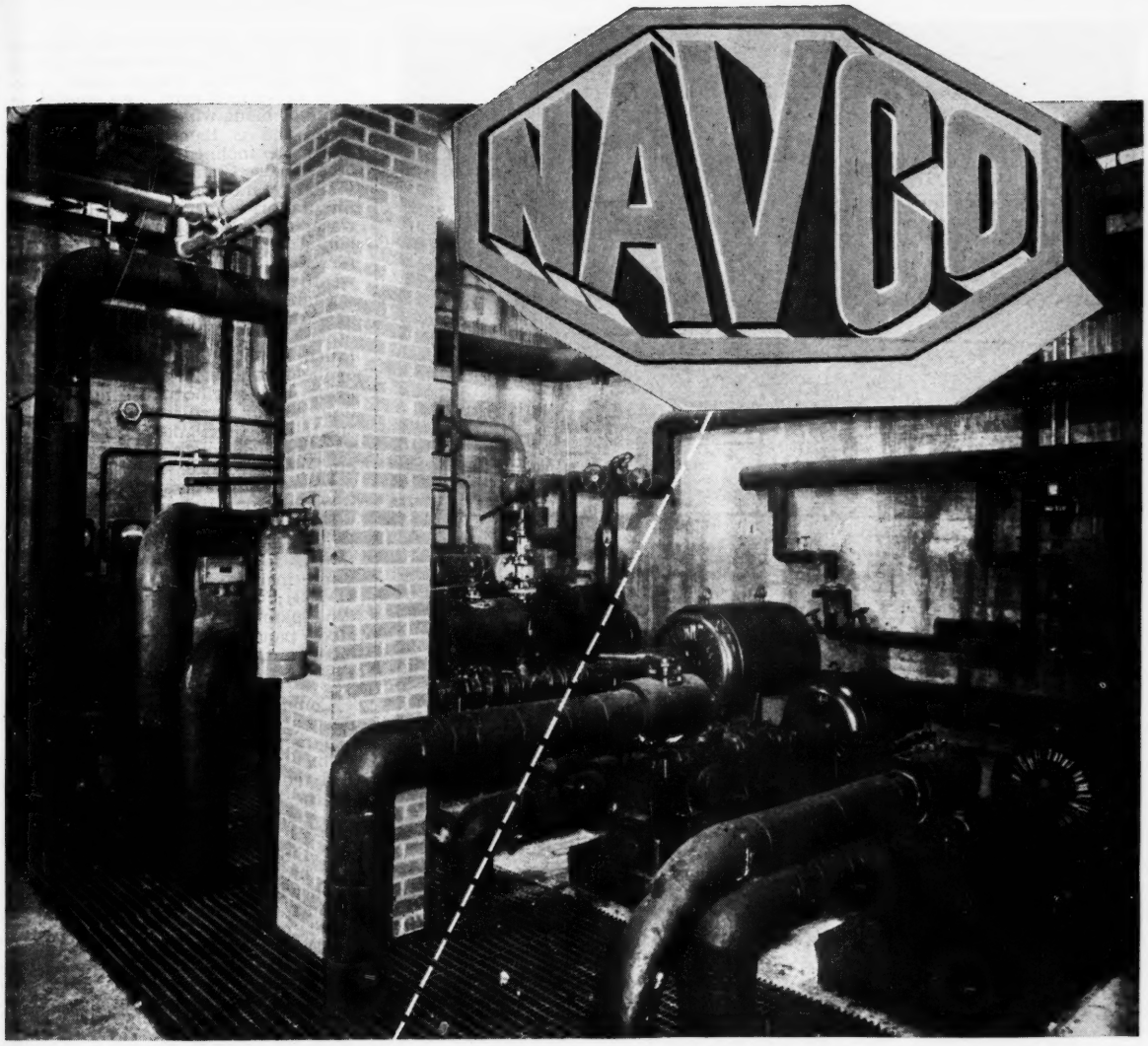
SEVERAL IMPORTANT new specifications and testing procedures for widely used materials were accepted by the American Society for Testing Materials' Committee E-10 on Standards at its August 27 meeting. Also, numerous revisions were approved for publication in existing formal standards and tentatives. Groups of recommendations came from technical commitees on electrical deposited metallic coatings; metal powders and powder products; paint, varnish, lacquer, and related materials; shipping containers; and water for industrial uses; also the committee responsible for methods of chemical analysis of metals.

All of these specifications, both new and revised, will be published by the Society during the fall, and in addition to being available separately will be included in the 1945 Supplement to the Book of Standards which will be issued late in December.

Paint, Varnish, Lacquer, and Related Products

Of the three new methods developed by Committee D-1 on Paint, Varnish, Lacquer, and Related Products, one is a test for evaluating degree of resistance of traffic paints to abrasion (D 821); another gives procedures for producing films of uniform thickness of organic finishing materials on test panels (D 820) and the third is a recommended practice for operating light and water exposure apparatus (carbon-arc type) for testing paint, varnish, lacquer, and related products (D 822). The traffic paint abrasion test is based on the use of photographic reference standards and the four illustrations give degrees ranging from two to eight. The method indicates that while gradings between the standards may be interpolated, the accuracy by visual means would not warrant interpolations in less than unit steps.

The method for producing films of uniform thickness of organic finishing materials on test panels (D 820) has three procedures: An automatic spraying machine which makes use of a spray gun moved over the test panel at an arbitrarily selected rate; an automatic dip coater which includes a mechanism to withdraw a



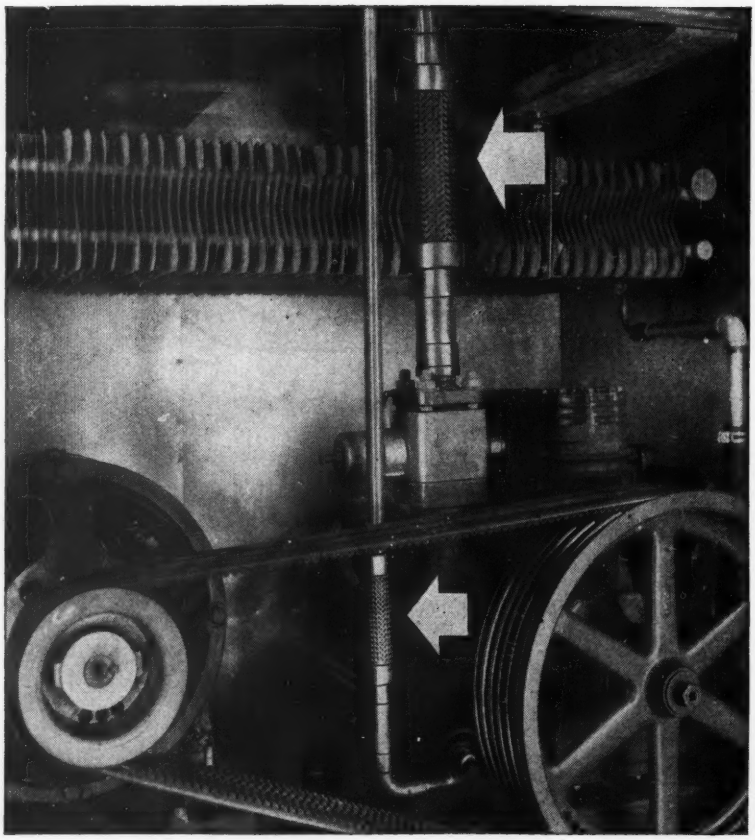
CORRECT DESIGN

Correct Design of a High Pressure-High Temperature piping installation insures economy of materials and safety in operation. The combination of Correct Design and Navco quality and workmanship insures you a piping installation of highest performance. Consult Navco for your next piping job.

NAVCO PIPING

NATIONAL VALVE & MANUFACTURING COMPANY • PITTSBURGH, PA.

NEW YORK • CHICAGO • CLEVELAND • BOSTON • ATLANTA • TULSA • BUFFALO



REX *Vibra-Sorbers*
Reduce Vibration Hazards

REX VIBRA-SORBERS—properly installed—substantially reduce servicing costs. For **REX VIBRA-SORBERS** have the exceptional strength and flexibility needed to absorb prolonged vibration and thus prevent the transmission of noises throughout the entire piping system.

In addition, **REX VIBRA-SORBERS** are pressure-tested to insure "refrigerant-tightness." This means greater protection against leakage of valuable refrigerants. **REX VIBRA-SORBERS** of copper bearing alloy are normally used for Freon and Menthol. Units of steel alloys are available for ammonia. Thus, effective corrosion resistance is assured in all types of installations.

Let experienced C.M.H. engineers help solve your vibration problems. Write today for full information.

Flexible Metal Hose for Every Industrial Use

ARMY E NAVY

CHICAGO METAL HOSE CORPORATION
MAYWOOD, ILLINOIS

Plants: Maywood and Elgin, Ill.

panel from a tank at a predetermined rate; and third, an automatic doctor blade applicator which under carefully prescribed conditions consists of a doctor blade which is filled with the paint and is then allowed to slide down an inclined test panel. The other new Committee D-1 method (D 822) is intended to establish means for uniform operation of light and water exposure apparatus of the carbon-arc type, which is sometimes referred to as accelerated or artificial weathering apparatus.

Numerous revisions were accepted in various pigment specifications and other paint material standards as detailed in the 1945 preprinted report of the committee. These changes will bring the specifications more up to date and in some instances permit a small percentage of surface treating agents. The materials involved include: pure chrome green, chrome oxide green, Prussian blue, ultramarine blue, titanium dioxide pigments, bone black, carbon black, lampblack. Other materials covered by existing standards which were revised include alkyd resin solutions (D 563); house paints and enamel-type paints (D 562); preparation of steel panels for exposure tests of enamels (D 609).

Industrial Waters

Committee D-19 on Water for Industrial Uses has issued several standard methods of determining various elements and ions in industrial waters and the three new methods accepted by the Society cover total aluminum and aluminum ion in industrial waters (D 857), manganese (D 858) and silica (D 859). In general these methods are intended to provide procedures from which the quality of water may be judged and to control water treatment operations. The method for silica is particularly important in boiler operations so that measures can be taken to prevent the formation of complex silicate scales and to reduce the tendency of the "embrittlement" of boiler metal. The new tentative recommended practice for sampling boiler water for stationery boilers (D 860) is another phase in the program to establish recognized methods for sampling in order to obtain the necessary analytical information to judge the quality of water.

Numerous technical papers and reports have covered procedures for testing for dissolved oxygen and after considerable study the subcommittee concerned proposed a standard test which included a method for referee and three non-referee procedures. The method of highest precision and accuracy was intended for acceptance testing of deaerating and for research testing of power plant equipment. It is essentially the so-called Navy method which has been described in papers by Dr. R. C. Adams and others. Non-referee method B is based on the Schwartz-Gurney Method as modified by Ulmer.

In the referee method it is indicated that a skilled operator can obtain a precision of 0.002 ppm and with an accuracy of 0.003 ppm or 1 per cent, whichever is the greater. Precision for the non-referee methods ranges from 0.004 ppm to 0.05 ppm of the true values. Because of numerous comments and some negative

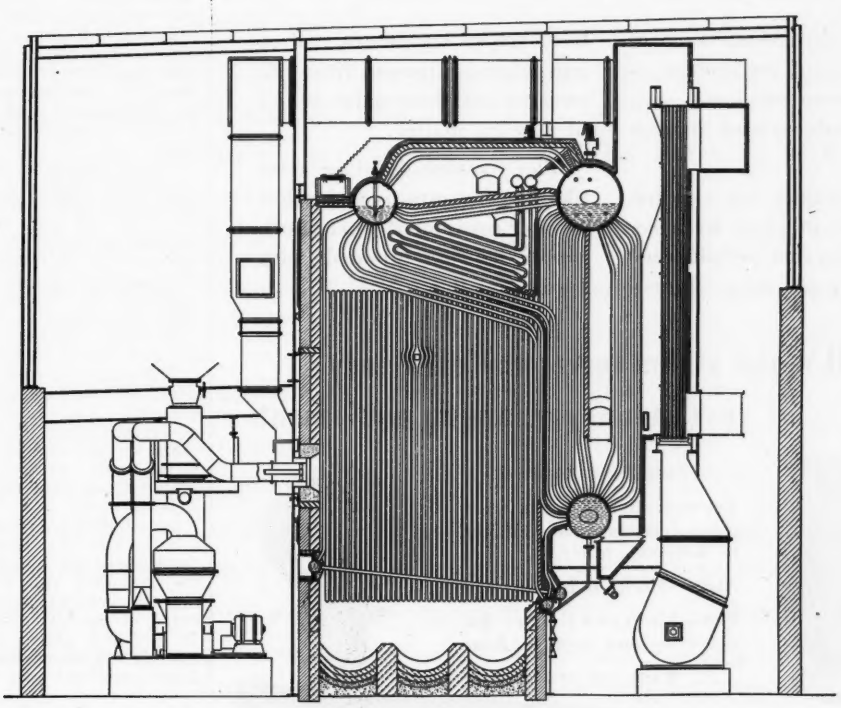
Edge Moor Radiant unit design embodies all the advantages of a 3-drum boiler with a water cooled furnace and maximum boiler tube surface exposed to radiant heat, all in a minimum of space.

This arrangement provides for large water storage, a generous steam liberation surface and a quiet offtake drum. Furnace cooling is disposed for a minimum of maintenance requirements and the best operation for the particular fuel to be burned.

The ability of the Edge Moor Radiant Heat Boiler to steam quickly and to deliver continuous high ratings is a matter of record. It is available in all sizes and pressures, and is adaptable to all fuels.

EDGE MOOR IRON WORKS, Inc., Main Office and Works, Edge Moor, Del. Branch offices: New York 1, N. Y., Empire State Building; Chicago 2, Ill., One No. LaSalle Street.

EDGE MOOR
RADIANT HEAT BOILER



Edge Moor radiant heat unit arranged for pulverized coal or liquid fuel firing. Equipped with superheater and Edge Moor vertical tubular air preheater.

EDGE MOOR
steam generating equipment

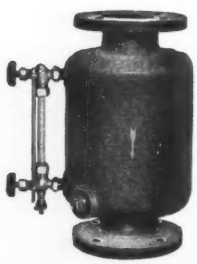
DIRT SHALL NOT PASS THRU ADSCO STRAINERS

Prevent shutdowns — prolong the life of equipment — increase steam efficiency with ADSCO Strainers and Separators.

The Y Strainer **has a screen that is held in place by a removable plug that permits easy removal for cleaning. It protects traps, regulators, valves and other equipment from the wearing and destructive action of foreign matter.**

The Suction Strainer **does likewise for pumps and other heavier equipment where bulk liquid is contaminated with foreign matter.**

Nor shall moist steam lower the efficiency of your steam consuming equipment



ADSCO SEPARATORS

Remove oil and water from steam—increase its efficiency by delivering it dry.

***Right*—Horizontal Type**

***Left*—Vertical Type for either up flow or down flow.**

Write for prices

PROTECT VALUABLE EQUIPMENT ... INCREASE STEAM EFFICIENCY WITH ADSCO STRAINERS and SEPARATORS

AMERICAN DISTRICT STEAM COMPANY

NORTH TONAWANDA, NEW YORK

Makers of "UP-TO-DATE" Steam Line Equipment For Over 65 Years

votes, it is planned to publish the proposed methods as information and for comment in the ASTM Bulletin.

Floating Power Plant for Belgium

ONE OF AMERICA'S floating power plants, which would look more at home on the Mississippi and was intended for waterways like that in the first place, has just been disclosed in the role of an ocean voyager that beat out a 51-day crossing of the Atlantic to generate part of Belgium's electric power after the Allies had liberated that country.

This craft, appropriately named the "Resistance," is capable of supplying the electric power needs of a city of 100,000, and is one of the floating power plants built to meet temporary power shortages expected in the U. S. A. in the early stages of the war production program. The "Resistance" was taken to Antwerp and hooked into the Belgium power system.

The plant is housed in a steel hull half a city block long. Power is generated by a General Electric hydrogen-cooled generator driven by a steam turbine. Steam is supplied to the turbine by two oil-fired boilers that can consume a half-million gallons of fuel oil in about seven days. The power lines were directly connected to the Belgian power lines in the Amsterdam hook-up by means of a 20-ft transmission tower built on deck.

Communications throughout the plant are made by telephones connecting the office and the CO's quarters with the main operating stations throughout the plant. In addition to the power-generating equipment on the barge, there is a machine shop equipped with lathes, grinders, pipefitting equipment, blacksmithing equipment, rigging, tinsmithing, and arc and acetylene welding equipment.

The plant operates four shifts and carries its own medic and has its own hospital. There are galley and mess accommodations. Quarters are provided for the regular crew with additional bunk space for the Merchant Marine crew that "sailed" her on the Atlantic trip.

Fire-fighting equipment consists of a battery of 76 cylinders of CO_2 piped throughout the plant. The fire-fighting chemical can be released from any of several control stations located at various places in the plant. In addition, above and below decks are high-pressure water hose connections supplied by the fire pumps.

Steam-Air Jet Used to Abate Engine Smoke

THE STEAM-AIR JET, if properly designed and applied with an adequate muffler, is an effective tool for engine crews in satisfactorily abating smoke, according to a paper presented at the fuels session of the Fall Section meeting of the ASME at the Hotel Netherland-Plaza in Cincinnati. The authors, R. B. Engdahl of Battelle Memorial Institute, Columbus, and E. D. Benton, fuel engineer of the Louisville and Nashville Railroad Co., one working in the laboratory and the other in the field, told how they had spent two years in research of this

Tougher tubes take the air

Tube failure occurred after 6 months' service in the inlet sections of main and auxiliary condensers of a turbine-driven Pacific Coast ship. Non-metallic inserts had been installed when severe inlet corrosion was observed. This early difficulty was followed by failure. Scovill was called in.

Laboratory examination disclosed a light brown protective film in irregular bands inside the tubes. Elsewhere severe pitting and thinning of the tube wall was found. The pits, irregular in shape, showed elongated tails in the direction of flow.

IRREGULAR ATTACK POINTS TO CURE

Searching further, the Scovill men found evidences of mechanical abrasion and erosion of the protective coating attributable to high velocity of the circulating medium containing entrained air. Non-metallic inserts had protected the tubes from inlet end erosion, but erosion-corrosion was found to be general throughout the length of the tubes.

The units were retubed with 70/30 Cupro-Nickel and no further failures were reported. Erosion-corrosion can often be minimized by preventing air leakage in circulating water and by eliminating turbulence and low pressure areas where dissolved gases can separate.

OTHER SCOVILL SERVICES

In addition to *Service in Men*, which includes assistance with installation problems and specialized advice on tube specifications, Scovill offers two additional services.

Service in Metals undertakes the selection of alloys and the study of specific problems both in the field and in the laboratory.

Service in Manuals offers valuable literature on condenser and heat exchanger tubes. Write for your copy of our Condenser Tube Booklet. Address Scovill Manufacturing Company, 17 Mill Street, Waterbury 91, Conn.

Scovill
MANUFACTURING COMPANY
WATERBURY 91, CONN.

CONDENSER TUBES
ONE PRODUCT . . . THREE SERVICES
Service in Manuals . . . Service in Metals . . . Service in Men

Even an unskilled laborer does a good job—*speedily*—with B-H No. 1 Cement. This unique product sticks *instantly*—on any surface; no sliding off or rolling up behind the trowel; no droppings when applied to under-surfaces. You get a neat, workmanlike job every time—without trouble and without waste.

B-H No. 1 Cement brings you many other advantages. Because its basis is *black* Rockwool—high in resistance to both heat and moisture—it resists temperatures up to 1800° F.—even under the most humid conditions.

Because it contains a special rust-inhibitor, it safeguards metal from corrosion and assures a permanent bond. Because its calcium content is low, its silica content high, it does not disintegrate.

B-H No. 1 Cement can be stocked without breakage or loss and is reclaimable up to 1200° F. Thus it is in every way *practical* for maintenance work—especially for valves, fittings and irregular surfaces, large or small, and as a finish over blanket and block insulations.

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☐ No. 100 Pipe Covering—effective up to 1200° F. (for long runs overhead, underground, Diesel exhausts)

☐ Mono-Block—the one-block insulation for all temperatures up to 1700° F.

☐ Black Rockwool Blankets (felted between various types of metal fabrics)

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practical solution to the smoke problem, experimenting with 15 railroads and about 350 engines. Bituminous Coal Research, Inc., was the sponsor of this work.

Increasing attention given smoke abatement during the war period and the certainty of increased legislation and enforcement policies after V-J Day prompted research of the steam-air jet. The effectiveness of the steam jet in abating smoke, by its ability of mixing air and combustion gases in the furnace, has been known for over 100 years. Yet little or no data were available from which an efficient installation could be made, resulting in haphazard design and often disappointing results. As a result of these investigations in 1943 by Engdahl, the optimum values of some hitherto uncertain design features, together with steam-air entrainment ratios when steam pressure, nozzle and air tube diameters were varied over a range of practical values, were made known for the first time. Other obstacles to general acceptance of steam-air jets were excessive noise and lack of automatic control. The noise item alone was enough to bar their use, particularly on switch engines when working between strings of cars which acted as a sounding board. About two years ago, both of the authors undertook to develop for the locomotive a practical muffler and a method of control which would be automatic and, also, modulate the quantities of overfire air in relationship to the amount of coal burned.

Harrington Wimberly Becomes Member of the Federal Power Commission

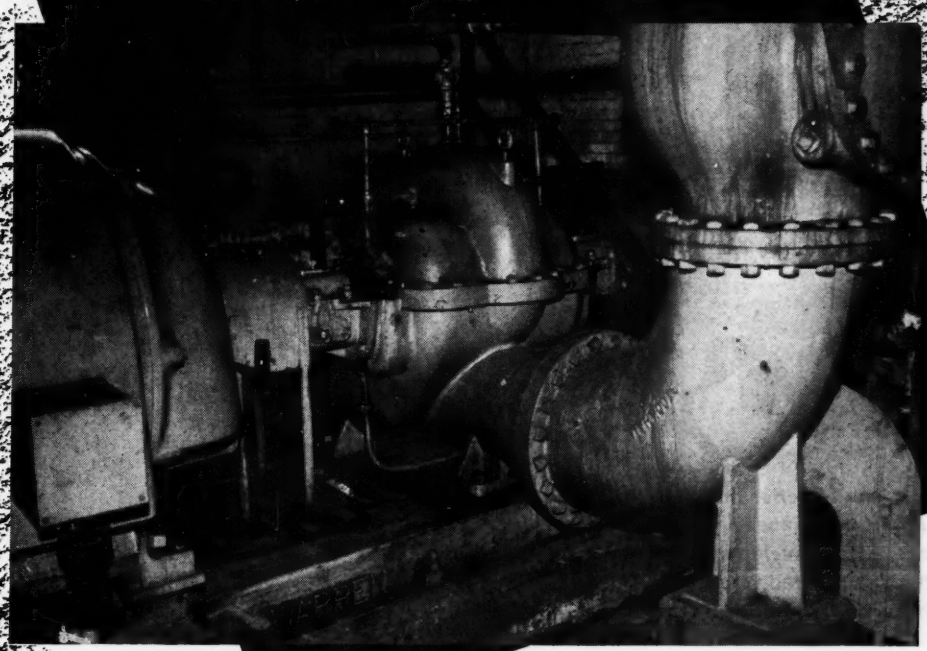
HARRINGTON WIMBERLEY, of Oklahoma, on October 5 was sworn in as a member of the Federal Power Commission for a term expiring June 22, 1948. Mr. Wimberly was appointed by President Truman to succeed Basil Manly, FPC Chairman, whose resignation became effective on October 1. The oath of office was administered by Acting Chairman Leland Olds.

Mr. Wimberly, owner and publisher of the Altus (Oklahoma) Daily Times-Democrat, served as Director of the Southern Newspaper Publishers Association from 1940 through 1943. He was director of the Oklahoma Press Association from 1935 to 1938 and president of that organization in 1937-1938.

In addition to his newspaper activities Mr. Wimberly served as Chairman of the Democratic State Committee of Oklahoma from February, 1944, until his resignation September 24, 1945. He was a member of the Board of Regents for the University of Oklahoma from 1940 to 1943 and was renamed a member of that Board by Governor Kerr in 1945 for a seven-year term. Mr. Wimberly was President of the Board in 1942. In 1944 he was named Public Interest Director of the Federal Home Loan Bank of Topeka, Kansas, and since 1936 he has been President of the Oklahoma Society for Crippled Children.

Richard Sachse, member of the California Railroad Commission, has been appointed by the President to fill the vacancy on the Federal Power

OIL REFINERIES DON'T GAMBLE *with* EQUIPMENT . . .



. . . INCLUDING PUMPS in the case of this large eastern seaboard refinery which has several Warren installations.

WARREN PUMPS

Among these is the salt water pump illustrated which has been on the job since 1936 . . . literally on the job with a perfect "attendance record". This is a 20" single stage, double suction, all bronze pump known as Warren 20-DL-22 Capacity, 14,000 GPM. Other DL type pumps available in capacities from 500 to 40,000 GPM.

For complete details ask for Bulletin 227

ARMY E NAVY

WARREN STEAM PUMP CO., INC.

WARREN, MASSACHUSETTS

Commission created by Commissioner John W. Scott's resignation on June 15. Mr. Sachse has not yet taken office.

Jobs for Disabled Workers

THE ASSOCIATION OF CASUALTY AND SURETY EXECUTIVES, public service organization of sixty-five capital stock and surety companies, has published a complete program to assist business and industry to meet the problem of placing disabled workers in productive and remunerative employment.

The program is concisely presented in a 36-page booklet, titled "The Physically Impaired—A Guidebook to Their Employment." Prepared by the staff of the Association's accident prevention division, the National Conservation Bureau, the manuscript was supervised throughout its writing by a committee of outstanding engineers and physicians and the finished document was edited by a jury of rehabilitation specialists of the War Manpower Commission, Veteran's Administration and large industries.

The booklet is fundamentally concerned with outlining seven steps for the proper placement of disabled workers, as follows: (1) adopt a clear policy; (2) survey job requirements specifically for the placement of physically impaired workers; (3) use a "standardized" interview to determine the applicant's interest, background and attitude; (4) analyze the applicant's physical capabilities with a medical examination; (5) place him in the correct job; (6) acquaint the worker with the job, using a planned procedure; (7) make a regular follow-up of his placement.

Those interested may secure copies of the Guidebook, without cost, by writing the National Conservation Bureau, accident prevention division, Association of Casualty and Surety Executives, 60 John Street, New York 7, N. Y.

4 reasons why WILSON EXPANDING BRUSHES mean dollars in your pocket

No tube cleaner is better than its "working end" — that is why an expanding brush can mean money in your pocket. Wilson — aware of this fact — has developed a BETTER expanding brush. Its exclusive features guarantee you a BETTER tube cleaning job—and lower maintenance costs. The photographs above show these features:

1 Exclusive patented one piece cartridge design; substantial channel walls prevent tufts from "punching through" while solid, long-wearing side walls together with spring-tempered tinned steel brush wires, assure longest brush life.

2 Replaceable retainer cap on front end takes wear at this point. When cap wears out, you can replace it at low cost and your brush is as good as new.

3 Air driven brushes are allowed to expand centrifugally while those operating on electrically driven equipment are spring expanded. This "tailoring to fit the job" assures faster, more thorough tube cleaning jobs.

4 Wilson Expanding Brushes for tubes from 1" to 2¾" have more brush cartridges than any other brush on the market. This means more cleaning surface, better cleaning and less brush wear.

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New ENGINEERING BOOKS

Elementary Engineering Electronics. With Special Reference to Measurement and Control. By Andrew W. Kramer. First edition, Cloth, 5 by 8¼ in., 344 pages. Published by Instruments Publishing Company, Pittsburgh, Pa., 1945. Price $2.00 postpaid.

HERE, at last,, is a book on electronics which is neither for schoolboys nor for mathematically-trained specialists, but for the great majority of men in industry (as well as in technical schools) who wish to acquire a working knowledge of electron tubes and circuits without becoming radio engineers—without being forced to study college-level mathematics.

The material in this book was published originally as a series of articles in POWER PLANT ENGINEERING in the years from 1936 to 1939. Subsequently, they were almost entirely re-written to bring them up-to-date and a great deal of new material added on "instrumentation and control" and published in Instruments Magazine from 1943 to 1945. From a life-long interest in electronics and as a pioneer in radio, the author is conscious of the difficulty the subject of electronics presents to the ordinary engineer having no background in this field, and for this reason uses all his skill and training acquired in 25 years in editorial work to make things clear and understandable to the uninitiated. He does not hesitate to repeat important statements in several modified forms, nor does he spare illustrations.

The book begins with a simple explanation of the nature of electricity and, with this as a foundation, proceeds logically to explain the action of all the different types of electron tubes in commercial use. Throughout the entire book no new principle or action is introduced until the fundamentals underlying such principle or action have been fully disclosed. Whenever possible, use is made of mechanical or hydraulic analogies.

Aside from the fundamental nature of the book its particular aim is to treat electronics with special reference to Measurement and Control—to what is becoming known as "Instrumentation." With this purpose in mind the author has avoided the temptation of going into the difficult details of radio, television,

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dieletcric heating, etc. It is true, "Instrumentation" might be called a specialty but since all technicians in all manufacturing industries, in all public utilities and in all fields of engineering education are keenly interested in measurements, "Instrumentation" is just about the most widespread of all specialties.

This book does not require the reader to have any previous knowledge of electronics; only of elementary electricity such as is possessed by any high-school graduate. It requires no mathematical training beyond the simplest algebra; only the easiest formulas are given and even these may be skipped by most readers interested in equipment.

Chapters are conveniently short; there are 34, from "The Nature of Electricity" to a "Conclusion" discussing "control" and "regulation." There are 259 numbered illustrations, many of them composite so that the actual number of diagrams exceeds 300. An index of six pages provides ready reference to the subject matter in the book.

Plastics. By J. H. Dubois. Copyright 1945, Third Edition, 5½ by 8½ in., 447 pages; cloth cover; published by the American Technical Society, Drexel Avenue at 58th Street, Chicago 37, Illinois, price $4.00.

This book is definitely for the user of plastics and not for the chemist or research laboratory. This fact was pointed out in noting the first edition of the book in Power Plant Engineering, August, 1942, and again in noting the appearance of the second edition in the March, 1944 issue.

This third edition, like its predecessors, explains in interesting form how various materials are put together to form plastics. It omits formal chemistry but explains what happens when various materials are handled in various ways, shows how all plastic materials are used, what can be made of them, where to use various kinds, how to form them, required tooling, machining, etc.

This edition carries forward the discussion of new materials and new methods to keep the book in step with recent developments and demands. The second edition was prepared early in 1942 but since that time the industrial effects of Pearl Harbor and Singapore have caused a tremendous acceleration of interest in the plastics material. The third edition reflects the new knowledge we have gained.

Chapter headings are as follows: An Introduction to Plastics; The Phenolic Plastics; The Urea or Amino Plastics; The Cellulose Plastics; The Acrylic, Vinyl and Styrene Plastics; The Cast Phenolic and Protein Plastics; Other Plastics Materials; Cold Molded Plastics and Shellac; The Laminated Plastics; Compression and Transfer Molding; Injection Molding and all the other molding processes and concludes with a fine chapter on trends and developments.

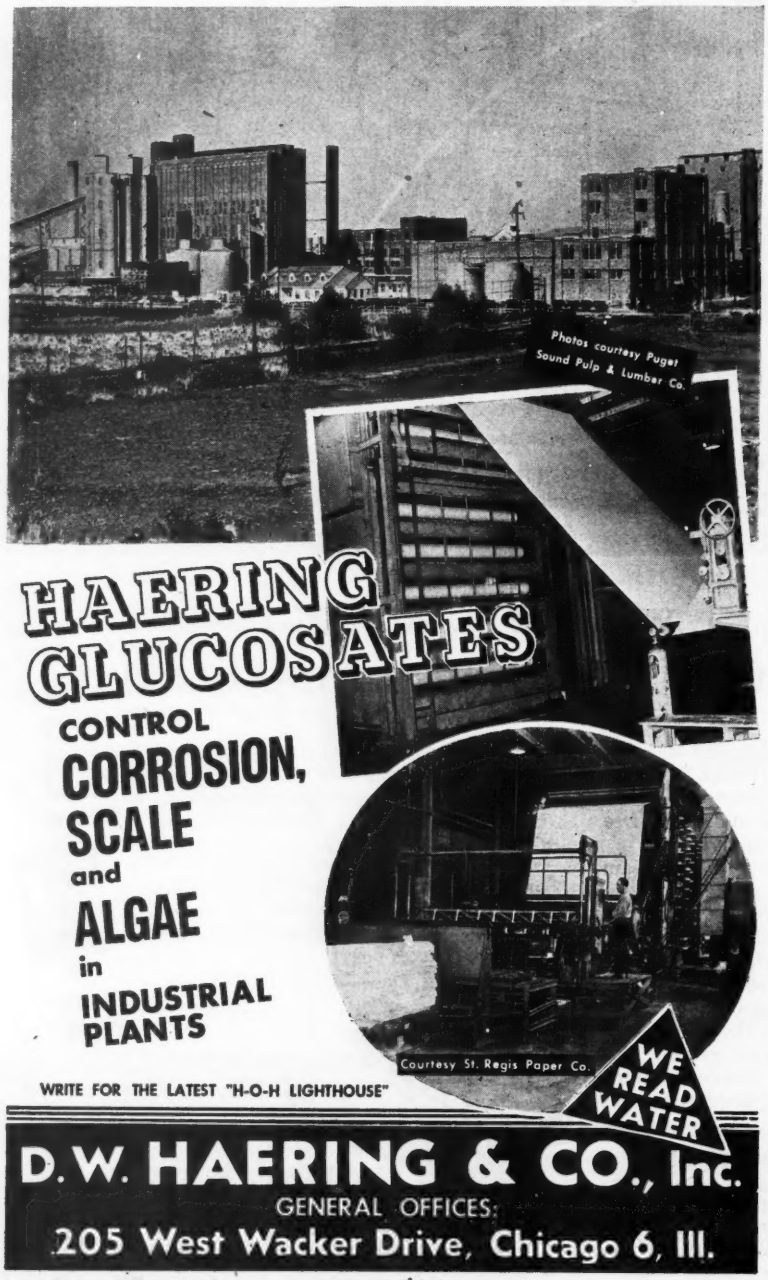
Dictionary of Engineering and Machine Shop Terms. By A. H. Sandy, Copyright 1944; 5½ by 8½ in.; 153 pages; cloth cover; published by Chemical Publishing Co., Inc., 26 Court Street, Brooklyn 2, New York, price $2.75.

This is the first American edition of a book by Mr. Sandy who is Instructor and Lecturer, Mechanical Engineering Department, Borough Polytechnic, London, England. It has been revised by I. E. Berck.

The author has endeavored to compile in this volume definitions of many important terms used in machine shops, industries and engineering literature. He points out that there are many common words and terms with shades of meaning peculiar to industry and engineering. Further, a new process brings into vogue a whole list of new words by the very fact that it is a new process. Some textbooks, the author says, give inadequate definitions of technical terms and this dictionary is intended to be of help in such cases.

The Hydrogenation of Coal at High Temperatures, Report No. 2, by J. L. Bray and P. W. Morgal, 36 pages, illustrated, paper, 6 by 9 in., Research Series No. 93, Engineering Experiment Station of Purdue University, Lafayette, Indiana.

This report summarizes the previous investigations of Messrs. Howard and Austin, confirming and extending Mr. Howard's Report No. 1. The effect of variations in temperature at a pressure of 1000 psi, the effect of variations in pressure at a temperature of 1050 F and the effect of variations in temperature at 5600 psi were studied and equilibrium conditions determined. For the benefit of other investigators, the operating technique for the high-pressure autoclave as well as certain special methods of analysis are described.



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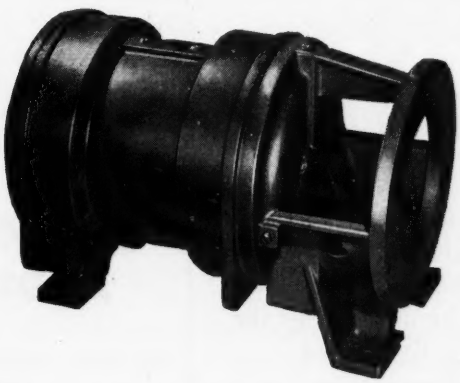
Clue No. 1: One-piece shaft carries motor-rotor and pump-impeller on ball bearings—assures alignment and smooth operation. Cast bronze sleeve shields it from liquid being pumped.



CLUE No. 2: One-piece iron casting forms motor yoke, the bearing housing, pump bracket and feet—gives stability to entire unit. Saves 33% space, lessens chance of strain on parts or piping.

FINE ENGINEERING adds up to quality and value—and that's what Allis-Chalmers "Electrifugal" Pump now offers you! Entire unit is designed for efficient, dependable service—gives you maximum protection against dangers of abnormal wear, leakage, corrosion, vibration. For further information call our nearby office, or write ALLIS-CHALMERS, MILWAUKEE 1, WISCONSIN. A 1929

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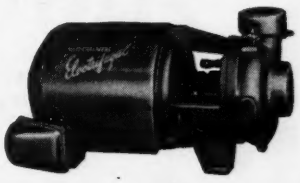
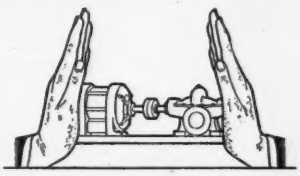
TO MOVE volatile liquids such as gasoline, kerosene, naphtha from tank-car to storage tank, and into trucks—a large petroleum company depends on A-C Electrifugal Pumps. Try-out of first 15 pumps was so successful (big test: surge-shock when valves snap shut!), 100 units were ordered, more later re-ordered.

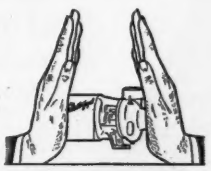


Electrifugal Capacities: 15 to 1600 gpm—heads up to 500 feet.

SQUEEZE PLAY CUTS PUMP SPACE 33%



How can we couple a pump and motor together *better*—to save space, provide stability, rigid alignment?



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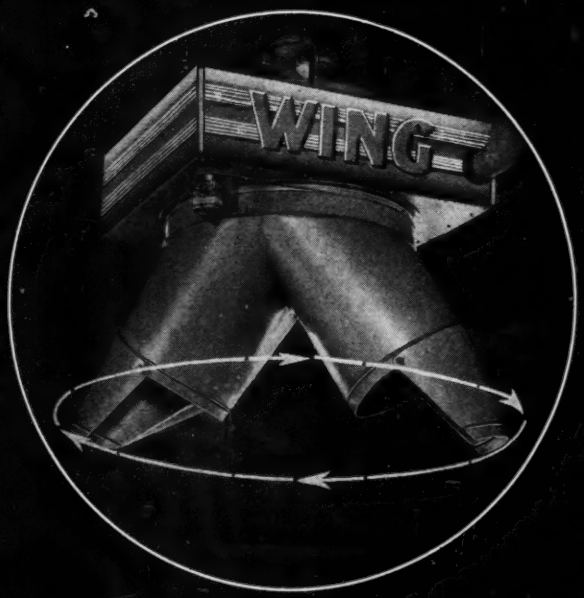

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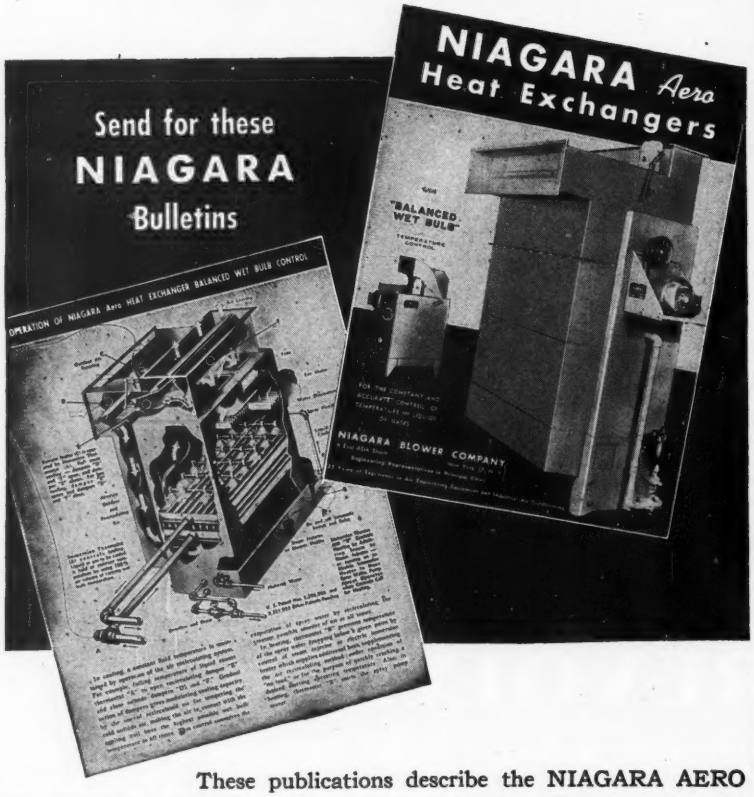

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The Viking Type R-18 Shut-Down System for Diesel Engines, is a unique mechanically-operated safety control to shut down a diesel engine when (1) lubricating-oil pressure becomes too low, or (2) circulating-water temperature becomes too high.

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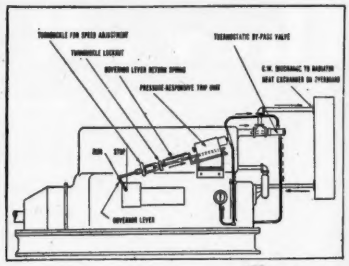
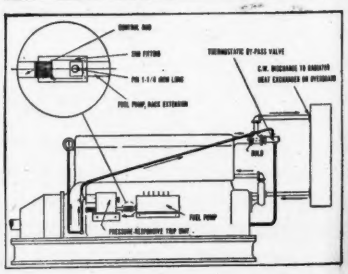
TYPICAL APPLICATIONS





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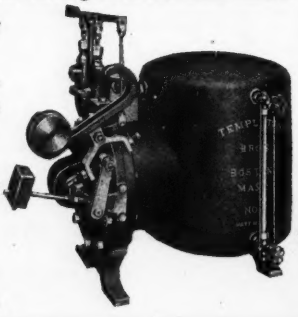
Open float cannot burst or waterlog.

Valves and Seat Bronze or Stainless Steel.

Sizes 1 in. to 4 in. inlet and outlet.

Capacity 2500 lbs. to 60,000 lbs. water discharge per hr.



Ask for catalogue and prices

TEMPLETON BROS., INC.
699 Main St. Walpole, Mass.

Your Blueprint for
MORE POWER
starts with
OAKITE CLEANING

Keeping Your Evaporative Coolers At Peak Efficiency

Evaporative cooler and condenser make-up water sooner or later becomes contaminated by mineral salts and slime. If allowed to remain, these accumulations build up to a point where their insulating power impairs heat transfer efficiency to such a degree that equipment's rated capacity is reduced . . . operating costs rise.

To assure peak day-in, day-out performance from your closed system evaporative water coolers and condensers treat your water supply with Oakite Airefiner No. 52. This material is specifically designed to hold lime in suspension so that it cannot collect as scale on coils . . . cannot clog spray jets. The potent germicidal and fungistatic properties of Oakite Airefiner No. 52 discouage the growth of slime and algae.

Interesting 4-page Field Service Report supplies complete technical data . . . explains precisely how Oakite Airefiner No. 52 can help you reduce equipment out-of-service time . . . cut operating costs. A free copy of this report gladly mailed, post paid, on request. Send for a copy TODAY!

OAKITE PRODUCTS, INC.
23 Thames Street, New York 6, N. Y.

Technical Service Representatives Located in All Principal Cities of the United States and Canada

OAKITE *specialized cleaning*

Buy Bonds for Victory

MATERIALS & METHODS FOR EVERY CLEANING REQUIREMENT

HEAT ENCLOSURES by DETRICK

What could we do to help modernize your present equipment? Our service engineers will gladly look over your setting and offer suggestions. Send print to Chicago

etrick Plastic Casing applied with a trowel fits closely place against the insulaon and provides a tight, eatherproof covering hich is also neat in ppearance.

As the demand developed for higher and higher furnace temperatures Detrick engineers, in at the beginning, have kept the pace offering improved construction and material application. Refractory furnace walls and arches have been designed to withstand high capacity conditions. The next step was insulated walls and arches to stop heat flow and now we have plastic casing which can be applied with a trowel which protects the insulation and gives a weatherproof finish. Each of these steps have been worked in a design that provides a maximum of effective life and a minimum annual cost.

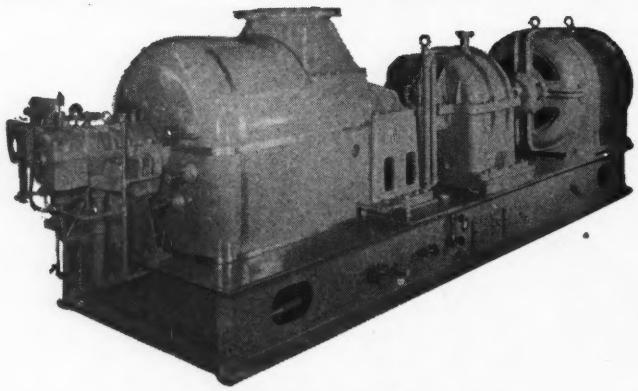
The principles learned in nearly a third of a century of engineering furnace enclosures have been described in a new book which illustrates these principles as applied to many types of furnaces. Engineers who wish to bring themselves up to date on this important subject should have a copy of this book which will be sent on request.

M. H. DETRICK COMPANY, 111 West Washington Street, Chicago 2, Illinois

DETRICK FURNACE ENCLOSURES

DETRICK INSULATION PLASTIC or BLOCK

MURRAY
TURBINE GENERATORS



500 KW—PACKAGE TYPE

The unit shown above was designed to deliver 500 KW 50 cycle alternating current on steam at 285# gauge, 700 degrees F., and exhausting condensing to 27 inches vacuum. Thirty identical units were furnished.

Equipment included trip and throttle valve, oil relay governor controlling single throttling inlet valve with hand valve control for partial load operation, all service connections above floor line except generator leads, drain piping brought to one point, and structural steel baseplate. The baseplate is sufficiently rigid so that the unit can be handled in one piece, and installed on the simplest of foundations.

While "Package Type" units are furnished for export for installation in remote areas not previously supplied with power, similar designs can be made for industrial plants for main or standby power supply.

MURRAY *also produces:*

Mechanical drive turbines, horizontal and vertical
Reduction Gears
Steam Boilers

MURRAY IRON WORKS COMPANY
BURLINGTON, IOWA
BUILDERS OF STEAM POWER EQUIPMENT FOR THREE QUARTERS OF A CENTURY

ALLPAX
THE PACKING THAT "PACKS ALL"
. . . use it once and
. . . you'll use it always

Here's the universal packing that can be used for any fluid or on any apparatus—economically, efficiently—tightly—simply.

Try ALLPAX and you, too, will be enthusiastic over its easy application and long wear. You don't have to remove old packing to repack with ALLPAX. Square cross section makes ALLPAX easy-filling in any stuffing box.

Try it and you'll always use it. Full details on request.

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Mamaroneck, N. Y.
Distributors Everywhere

PRINCO

INDUSTRIAL THERMOMETERS FOR POWER PLANTS

STANDARD AND HEAVY-DUTY MODELS

FOR SUPERHEATED STEAM
FOR CIRCULATING WATER
FOR FEED WATER
FOR CONDENSATE
FOR LUBRICATING OIL
FOR FUEL OIL
FOR FLUE GAS
FOR REFRIGERATION

COMPLETE LINE OF SEPARABLE SOCKETS, TEST WELLS, AND ARMORED TEST THERMOMETERS

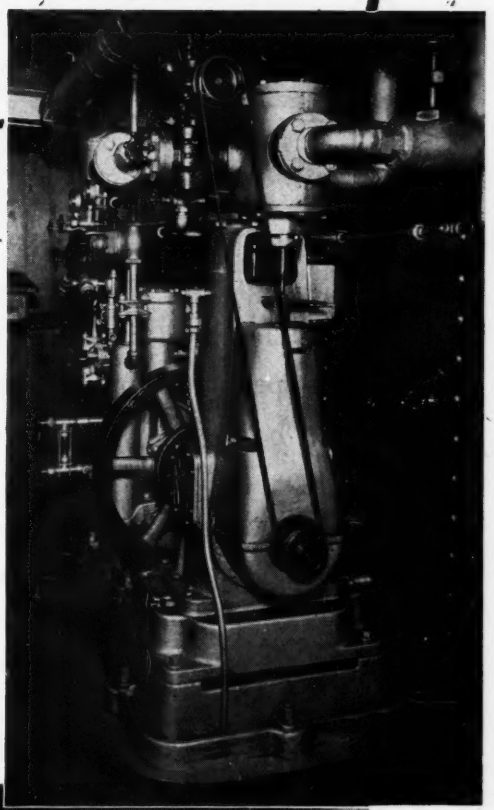
Write for Bulletin "E"

PRECISION THERMO[illegible]OMPANY

PRINCO
PRECISION INSTRUMENTS FOR INDUSTRY

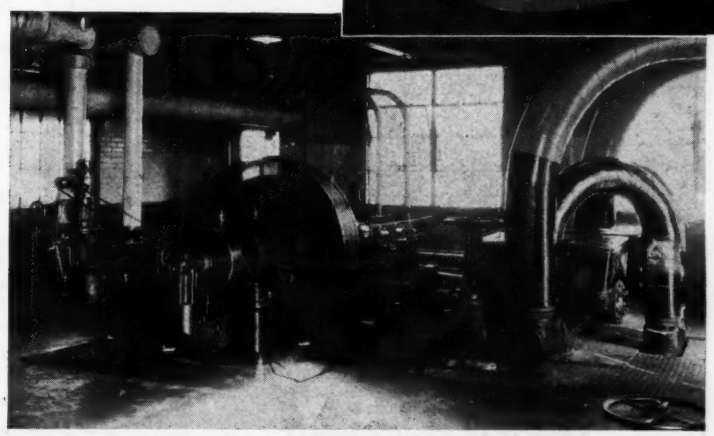
1421 Brandywine Street, Philadelphia 30, Pa.

One More Place to Look
FOR REDUCTION IN POWER COSTS



IMPROVED DESIGNS of stokers and boilers are helping plants offset rising fuel and labor costs in steam generation, but that is not the limit to which economies can be carried. In most plants where steam is generated for processing purposes another important saving can be made by utilizing By-Product Power in the steam.

In many cases, steam passes through a pressure reducer before passing to its ultimate destination. To obtain By-Product Power pass the steam through a Troy-Engberg Steam Engine, instead of the pressure reducer. The power thus converted can be used to drive generators, stokers, compressors, ventilating systems and many other types of equipment. Power savings thus effected will quickly pay for your Troy-Engberg Engine—in some instances in as little as six months.



Ask for Troy's recommendations in your own set-up. There is no obligation, of course.

Send for Bulletin 306

TROY ENGINE & MACHINE CO.

Established 1870

882 Railroad Avenue **Troy, Pennsylvania**

13-TEM-4

BUY VICTORY BONDS AND HOLD THEM

☆ ☆

Help bring our boys back to the homes for which they fought—give our wounded heroes the best of medical care—help promote peacetime prosperity for returning veterans and yourself—by backing the Victory Loan.

No American smart enough to buy Victory Bonds will want to cash them unless an emergency arises. The interest you receive on "E" Bonds is 2.9%, almost 3% from the time of purchase until the bonds mature in ten years, or $4 for every $3 invested. It is smart to buy Victory Bonds. It is still smarter to hold on to them if you possibly can.

VICTORY LOAN

INCREASES BOILER EFFICIENCY

YOU CAN CHECK the efficiency of XZIT in your boiler room. Stack temperatures definitely prove that XZIT substantially increases operating efficiency and improves heat transfer by removing soot and fire-scale from all surfaces of the firebox and stack.

XZIT, fed into the flame, does its work while the boiler is in operation. It keeps the boiler free of soot and fire-scale when used at regular intervals. Try XZIT today—stocks are available in all localities.

XZIT FIRE SCALE & SOOT ERADICATOR

1031 CLINTON STREET, HOBOKEN, N. J.
5800 S. HOOVER, LOS ANGELES, CALIF.

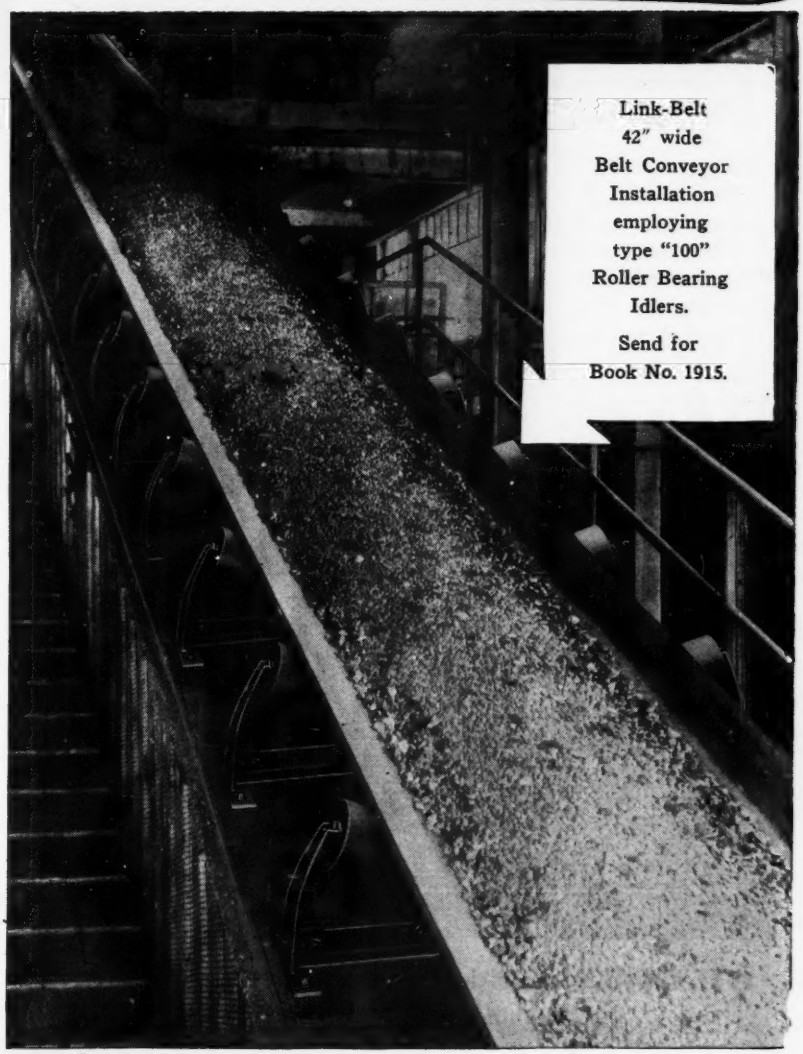
THE "ROAD" to EFFICIENT BELT CONVEYING

LINK-BELT

BELT CONVEYOR IDLERS

● Top performance in belt conveyors depends, in a great measure, upon the structure on which the load moves. So, begin at the beginning and make sure you select the right type. Link-Belt Roller Bearing Belt Conveyor Idlers are the outgrowth of almost 50 years of constant development. Engineering development that has kept pace with growing service needs, has achieved outstanding design in today's Link-Belt Idlers.

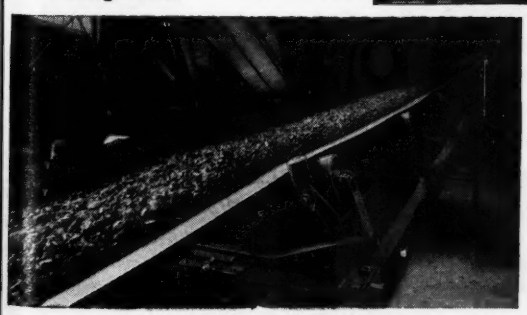
There are good reasons why they perform with minimum power and maintenance—operate smoothly and dependably, and add to the ordinary life of the conveyor belt. Catalog sent on request.



Link-Belt 42" wide Belt Conveyor Installation employing type "100" Roller Bearing Idlers.

Send for Book No. 1915.

Assure longer life to conveyor belts by using Link-Belt Self-Aligning Idlers. They automatically maintain the conveyor belt in a central carrying position without injury to its edges. Made in two types for regular or reversing travel.



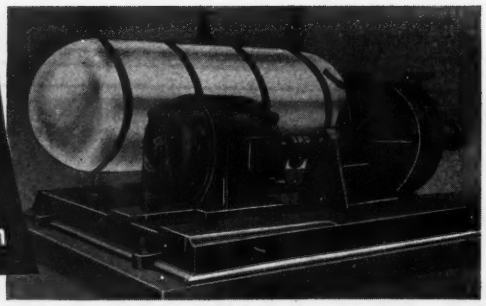
LINK-BELT PRODUCTS INCLUDE: Conveyors and Elevators of all types—Belt, Apron, Pan, Bucket, Chain, Bulk-Flo, Sidekar-Karrier, Oscillating-Trough, Flight, Screw, etc. . . . Feeders . . . Vibrating Screens . . . Skip Hoists . . . Car Spotters . . . Silent and Roller Chain Drives . . . Speed Reducers . . . P.I.V. Gear Variable Speed Changers . . . Chains and Attachments of all types . . . Malleable Iron, Promal, and Steel . . . Sprockets . . . Gears . . . Clutches . . . Couplings . . . Base Plates . . . Take-Ups . . . Babbitted, Ball and Roller Bearings . . . Grease Cups . . . Safety Collars . . . Shafting, etc.—everything from one source to make your materials handling and power transmission machinery operate at peak efficiency. Send for Catalogs.

LINK-BELT COMPANY

Chicago 9, Indianapolis 6 Philadelphia 40, Atlanta, Dallas 1, Minneapolis 5, San Francisco 24, Los Angeles 33, Seattle 4, Toronto 8. Offices in Principal Cities.

9994-B

Increase
YOUR PRODUCTION
with the
STOUT NO-VENT
Boiler Return System



—for Cookers, Heaters, Driers, etc.

It operates continuously returning condensate, ALL OF IT, fast as formed and at the same pressure and temperature at which it leaves the steam heated units. Air and non-condensibles are then automatically removed and the condensate, in the form of distilled water, returned direct to boiler. There are no traps or orifices in the system.

High temperature direct return saves fuel. Often 25% or more. (This would offset the 20% cut expected in soft coal deliveries to industry as announced July 14th by Secretary Ickes.)

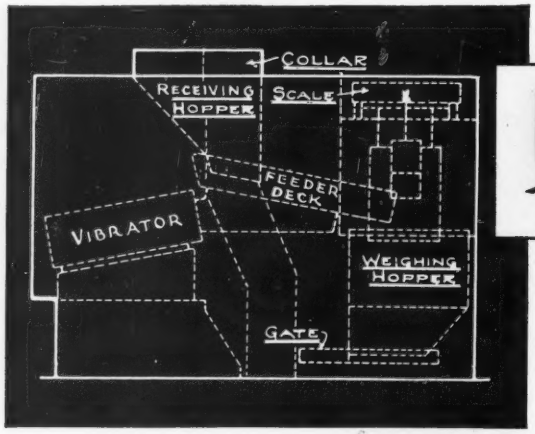
Improved circulation the Stout NO-VENT way uniformly increases the temperature in steam heated units and increases production. Reducing boiler load and returning distilled water prolongs boiler life.

If you operate steam heated cookers, heaters, driers, ironers, clothing presses, drying ovens, oil tanks, water tanks, pickling tanks or have other uses for so-called "process steam" investigate the Stout NO-VENT Boiler Return System. It can boost your production.

DAVID STOUT & SONS • 6 N. Michigan Ave. • CHICAGO 2, ILL.
Heat Reclaimers • Steam Condensers • Spiro Water Heaters • Gas Fired Boilers

Write for bulletin showing hookup of Stout NO-VENT System and giving operating details. Made in capacities 100 to 800 bhp, pressures to 200 lb. Distributors will be interested in selling franchise.

Stout NO-VENT BOILER RETURN SYSTEM



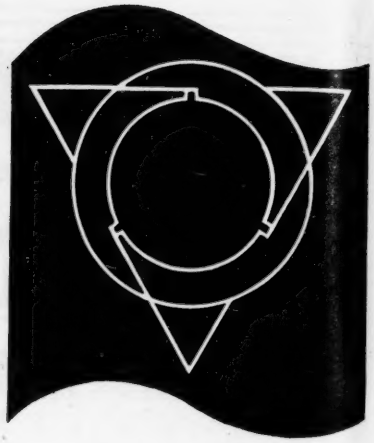
Features:
Pat. applied for.

- No rotating parts
- High weighing accuracy
- Dustproof cabinet
- Quiet operation
- Long life
- Handles wet material

WET COAL can't stick to the Beaumont "Vibro" Automatic Weighing Scale Feeder.

No rotating parts in the Beaumont Scale to which wet coal can stick. Simplified design ensures accurate—automatic—weighing of coal, and similar materials. Feeder capacity adjustable. Units made for feeding materials at from 1 to 60 tons per hour. Request descriptive bulletin.

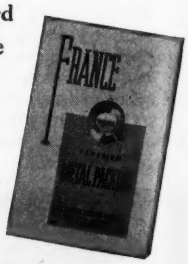
BEAUMONT BIRCH COMPANY
1503 RACE STREET PHILADELPHIA 2, PA.
DESIGNERS • MANUFACTURERS • ERECTORS OF COAL AND ASH HANDLING SYSTEMS



PREVENT
ROD SCORING,
save power

"Full-floating" FRANCE rings in metal cases make a snug seal and compensate for rod deflection or misalignment—the ideal packing for piston rods and valve stems in any type of engine, pump or compressor. Wears as long as any other working part of the engine—saves power and prevents costly power shutdowns.

There is a time-tested FRANCE Packing design for steam, air, gas and crankcase oil service under any condition of speed, pressure or temperature. Recommended and used for years, the world over — Standard Packing of the Industry.



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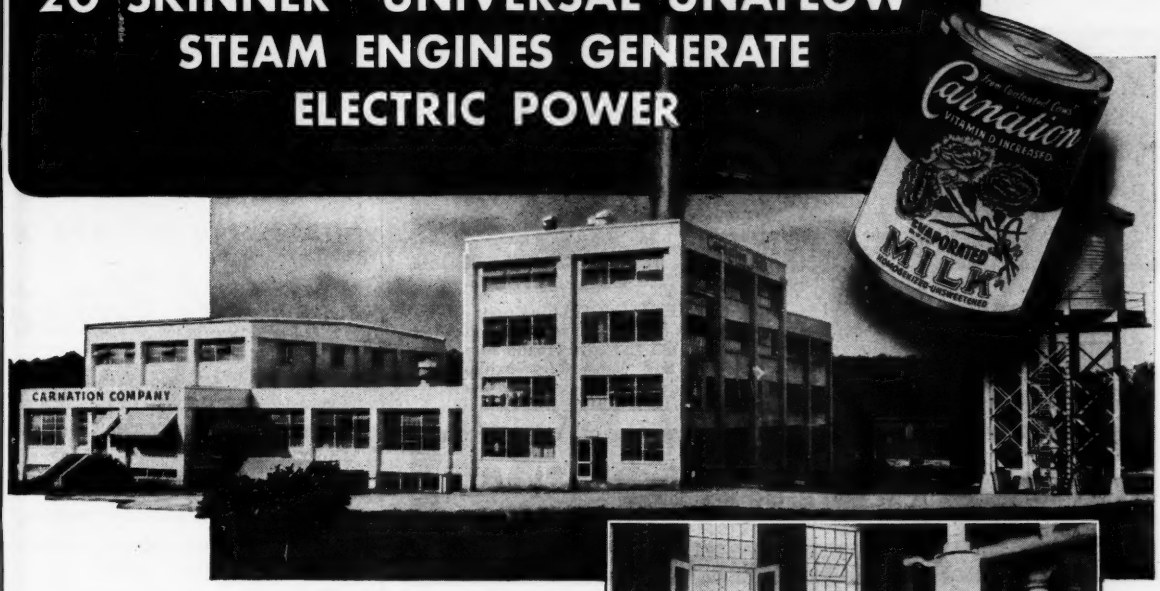
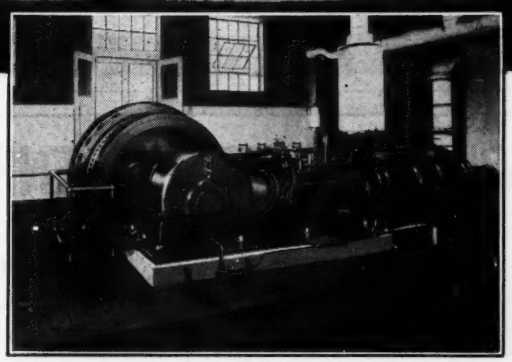
FRANCE *Packing Company*
PHILADELPHIA 35, PA.
Representatives in Principal Cities

In 16 Evaporating Plants of the CARNATION COMPANY

20 SKINNER "UNIVERSAL UNAFLOW" STEAM ENGINES GENERATE ELECTRIC POWER





The modern Carnation plant at Mt. Vernon, Mo., and a "Universal Unaflow" Engine-Generator Unit, typical of 20 which provide electric power in 16 of the company's 32 plants.

As Carnation Company approaches the half-century point of its remarkable history, its products are known and used in the far corners of the earth. Producer of the world's leading brand of evaporated milk "from contented cows," The Carnation Company furnishes an outstanding illustration of American success, sparked by the genius and vision of its founder, E. A. Stuart, and growing in the encouraging atmosphere of a system of free enterprise.

As a typical example of Carnation's efficiency, 20 Skinner "Universal Unaflow" Steam Engines generate economical and dependable electric power in 16 of the company's 32 evaporating plants. Not only is light and power produced at a fraction of the cost of purchased power, but exhaust steam from the engines is effectively utilized in the processing of evaporated milk and other products.

More than two thousand power users, in industries and institutions of various types, have found it more economical to generate their own electric power with Skinner "Universal Unaflow" Steam Engines than to purchase power from the local utility, or to generate their power with other prime movers. Skinner engineers will give you an accurate estimate of your potential savings before you spend a cent.

★ *BUY VICTORY BONDS* ★

ARMY E NAVY

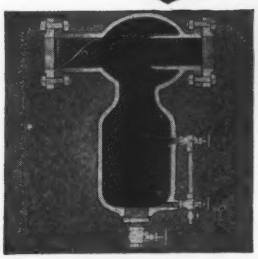
For Over 75 Years, Doing One Thing Well—Building Steam Engines

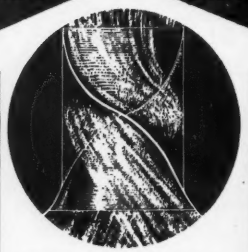
SKINNER ENGINE COMPANY, ERIE, PA.

The Whirl Does the Trick

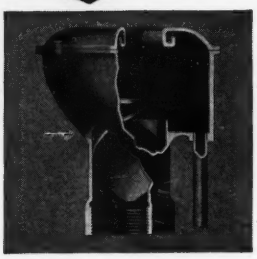
of purifying your steam & oil through **Swartwout Separators**

of drying exhaust steam through **Swartwout Exhaust Heads**





The Swartwout Helix gives the entering steam a *positive* whirling motion that throws aside all impurities.



A HIGH DEGREE of separation is gained through Swartwout Separators with practically no pressure drop. Made in vertical and horizontal styles in a range of sizes. Bulletin S-14-B sent upon request.

THE SAME PRINCIPLE as used in Swartwout Separators works as efficiently in the Exhaust Heads to remove oil and water from exhaust steam. Made in wide range of sizes. Bulletin S-16-A sent upon request.

Swartwout POWER PLANT EQUIPMENT

THE SWARTWOUT COMPANY • 18511 Euclid Ave., Cleveland 12, Ohio

JOHN PHILLIPS BADENHAUSEN

INCORPORATED

43 Years Experience in Power Plants

BADENHAUSEN BOILERS • SUPERHEATERS
FIRING SYSTEMS • SAWDUST BURNERS

After consulting us, a coke company in Philadelphia doubled the steam output of its boilers. Additional steam was made in the furnaces, with no increasing draft loss and no loss in efficiency. And no costly new investment in boilers, housing, stacks, etc.

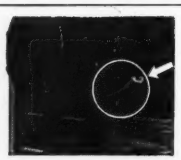
How to increase the steaming capacity of existing boilers is one problem that John Phillips Badenhausen engineers have often solved.

Further information gladly submitted on request

18TH FLOOR, PACKARD BUILDING, PHILADELPHIA 2, PA.

"Boiler Repairs Reduced 75%"

writes user of **NATIONAL GIRTH SEAM PROTECTOR**



We have been using the National Girth Seam Protector for several years and they certainly do the job. . . . Have reduced our boiler repairs at least 75% since using these protectors, one of the best investments we ever made.

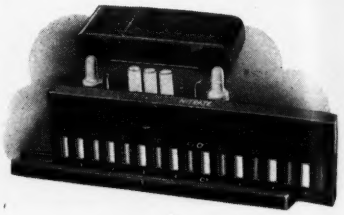
Von Platen-Fox Co.
Iron Mountain, Mich.

You, too, will find the National Girth Seam Protector saves trouble and money by preventing leaks and fire-cracking on new or old seams in boilers. Sections consist of wedge nut, cap screw metal lug and refractory covering; are easily attached. We can make immediate deliveries. Send for descriptive bulletin.

NATIONAL BOILER PROTECTOR CO., 740 REIBOLD BLDG., DAYTON, OHIO

TAYLOR *Does It Again!*

THE NEW TAYLOR-BETZ



NITRATE SLIDE COMPARATOR

Controls Nitrate

IN BOILER WATER!

Because nitrates are now being used extensively in boiler water to control caustic embrittlement and because a positive method for determining nitrate concentration has been needed . . . TAYLOR DOES IT AGAIN . . . with the New Taylor-Betz Nitrate Slide Comparator.

This new, important and vitally needed outfit adds to the utility of Taylor Phosphate and Boiler Water Comparators, because the Nitrate Slide can be used with the base of either of these sets. And, of course, accuracy is assured as all Taylor Liquid Color Standards are guaranteed not to fade.

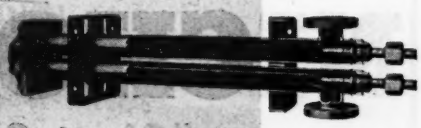
Complete Taylor-Betz Nitrate Slide Comparator.....$18.00
Nitrate Slide only, with reagents and accessories.....$ 9.70
With Wooden Carrying Case..$25.00

NEW 88 PAGE DATA-REFERENCE BOOK, "MODERN pH AND CHLORINE CONTROL," FREE!

Gives you specific applications of Taylor Comparators in 34 leading industries . . . also describes all Taylor Liquitrol Methods, procedures and outfits. *An extremely useful book.* Get your copy from your dealer or write direct.

W. A. TAYLOR AND CO.
7301 YORK RD. • BALTIMORE-4, MD.

RANGE



OF SIZE AND SERVICE

G-FIN...

the most widely applicable heat transfer surface

Here's a fact of significance to all users of heat transfer apparatus... G-Fin elements are applicable to every type of unit.

The list would be almost endless . . . it includes heaters, coolers, condensers, heat exchangers; the range covers small twin sections to enormous alkylation contactor bundles; and the fluids handled include practically every liquid, vapor and gas, clean or dirty, light or heavy, at pressures up to 2000 lb. and at temperatures well over 1000°F.

There are many reasons for the wide adaptability of G-Fin elements. This patented design of heat transfer surface is far more effective than bare tubes for transfer of heat to or from fluids of high viscosity or low heat conductivity . . . it can be used in standard, interchangeable units that form installations of flexible capacity . . . it provides fluid passages of uniform cross-sectional area and high velocity to prevent clogging . . . and the units in which it is used can be made particularly sturdy, convenient to handle, and with minimum maintenance.

Write for bulletins describing the application of G-Fin elements to services in which you are interested.

THE GRISCOM-RUSSELL CO.

285 Madison Ave., New York 17, N. Y.

ONLY G-R BUILDS THIS WIDE VARIETY OF HEAT TRANSFER APPARATUS

SHELL and BARE TUBE
Heaters, Coolers, Condensers, Heat Exchangers

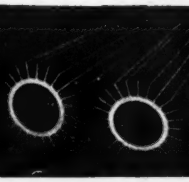
G-FIN
Longitudinal-finned elements for greater heat conductivity

K-FIN
Helical-finned elements for vapors and gases

BENTUBE SECTIONS
with scale-shedding elements for hard or salt water

TUBEFLO SECTIONS
Non-clogging design for residuum and other dirty fluids

GRISCOM-RUSSELL
TWIN G-FIN SECTION
The Universal Heat Exchanger

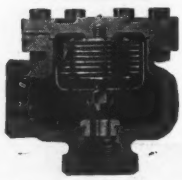


PERFORMANCE RECORDS POSITIVELY SHOW YOU CAN PROMOTE EFFICIENCY
with

NICHOLSON

"Plant-Proved"

TRAPS

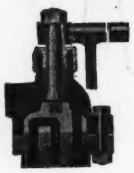


Nicholson Thermostatic Steam Traps have largest discharge capacity of any trap in their price range. Cannot freeze, water-log or air-bind. 5 types: Size ¼" to 2". Sent on trial. Bulletin 544.

FLOATS

Nicholson Welded Floats are of stainless or chromium-plated steel: spherical, cylindrical, elliptical. For every heavy-duty use. 2" to 14". Bulletin 345.

VALVES



3-way valves for single, 4-way for double-acting cylinders; multi-port, metering, distributing, special types. For air, steam, oil, gas, tar, water. Lever, foot, solenoid, motor-operated types. Catalog 543.

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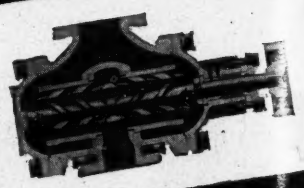

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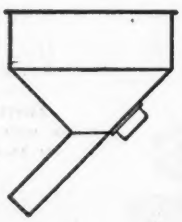

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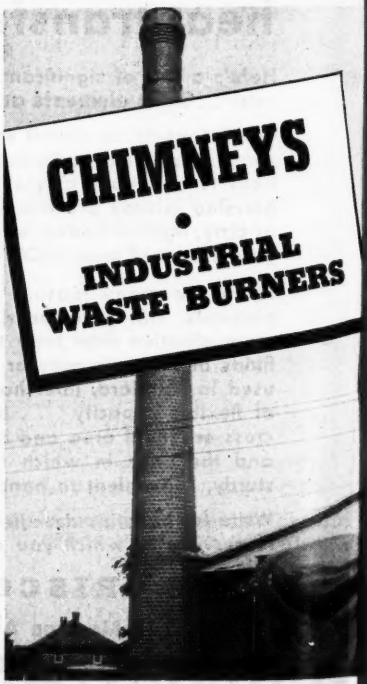

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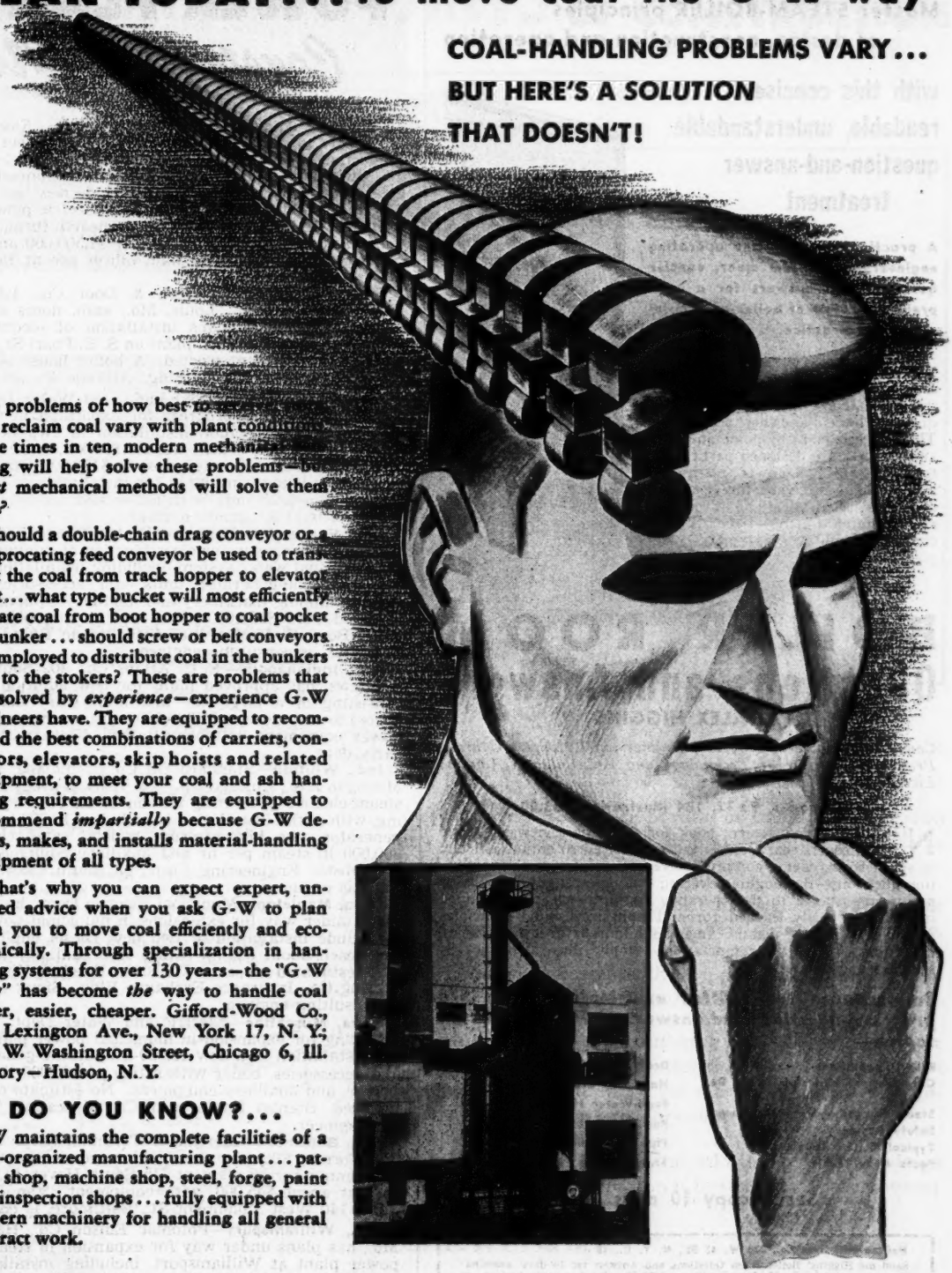

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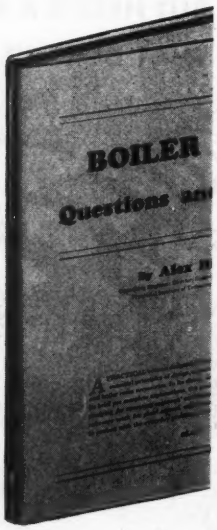

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POWER PLANT *Construction News*

Calif., Los Angeles—Bethlehem Steel Co., East Slauson Ave., Vernon district, plans extensions in power plant in connection with large expansion program at local steel mill, with installation of additional equipment for increased capacity. Program will include new bar, rod and wire mills, and several other units. Electric power equipment will be installed. A new open-hearth furnace will be built. Entire project will cost over $7,500,000 and will be carried out during 1947. Main offices are at Bethlehem, Pa.

Ga., Atlanta—Huttig Sash & Door Co., 1206 South Vandeventer St., St., Louis, Mo., sash, doors and other millwork products, plans installation of electric power equipment in new branch plant on S. E. Pearl St., Atlanta, where site has been selected. A boiler house is planned. Burge & Stevens, Palmer Bldg., Atlanta, are architects.

Ind., Bluffton—Municipal Light and Water Dept., City Bldg., has plans in progress for expansion in municipal power plant, to include installation of two new Diesel engine-generators, each about 800-kw, and auxiliary equipment. Cost estimated close to $160,000. An alternate program is being considered for installation of a 1600-kw turbine-generator unit, with boiler and accessories. B. H. Freeland is plant superintendent.

Ind., Evansville—Board of Water Trustees, City Hall, has plans under way for electrification of pumping station for municipal water system, including installation of three Diesel engine-generator units and accessories, motor-driven pumping machinery and auxiliary equipment. Cost reported over $850,000. Proposed to ask bids early in 1946. Boyd E. Phelps, Inc., Brinckmann Bldg., Michigan City, Ind., is consulting engineer.

Ind., Indianapolis—E. C. Atkins Co., 402 South Illinois St., saws, has approved plans for new addition to plant, consisting of a large one and multi-story building, reported to cost close to $1,300,000, with machinery. Electric power equipment will be installed. Work will begin at early date.

Ind., Whiting—Standard Oil Co. of Indiana, 910 South Michigan Ave., Chicago, Ill., has plans in progress for new steam-electric generating station at oil refinery at Whiting, with initial installation to include a 10,000-kw turbine-generator, two high-pressure boilers, rated capacity of 300,000 lb steam per hr and auxiliary equipment. Stone & Webster Engineering Corp., 33 South Clark St., Chicago, is engineer.

Iowa, Mapleton—Municipal Electric Dept., has tentative plans under way for extensions in municipal power plant, to include installation of two new Diesel engine-generators, each about 600-hp rating, and auxiliary equipment. Cost estimated close to $100,000. Buell & Winter Engineering Co., Insurance Exchange Bldg., Sioux City, Iowa, is consulting engineer.

Iowa, Muscatine—Electric and Water Dept., has plans maturing for expansion in municipal power plant, including installation of a new 12,500-kw turbine-generator unit and accessories, boiler with rating of 160,000 lb of steam per hr, and auxiliary equipment. No estimate of cost announced. Stanley Engineering Co., Muscatine, is consulting engineer.

Md., Baltimore—Merchants' Terminal Corp., Monument and Forrest Sts., has plans under way for new one-story ice-manufacturing plant at 715 South Haven St., reported to cost about $45,000, with equipment. Van Rensselaer Saxe, 140 West Monument St., Baltimore, is engineer.

Md., Williamsport—Potomac Edison Co., Hagerstown, Md., has plans under way for expansion in steam-electric power plant at Williamsport, including installation of a 30,000-kw, turbine-generator unit, additional boiler and auxiliary facilities. Cost reported about $4,000,000. Proposed to begin work early in 1946. Plans also have been authorized for new transmission line from Millvillem, W. Va., to Double Toll Gate, Va., near Winchester, Va., to cost approximately $200,000. Work scheduled to proceed next spring.

Mass., Florence—Propper-McCallum Hosiery Co., Inc., Northhampton, Mass., plans installation of electric power equipment in proposed new additions to mill at Florence.

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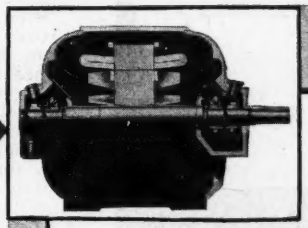

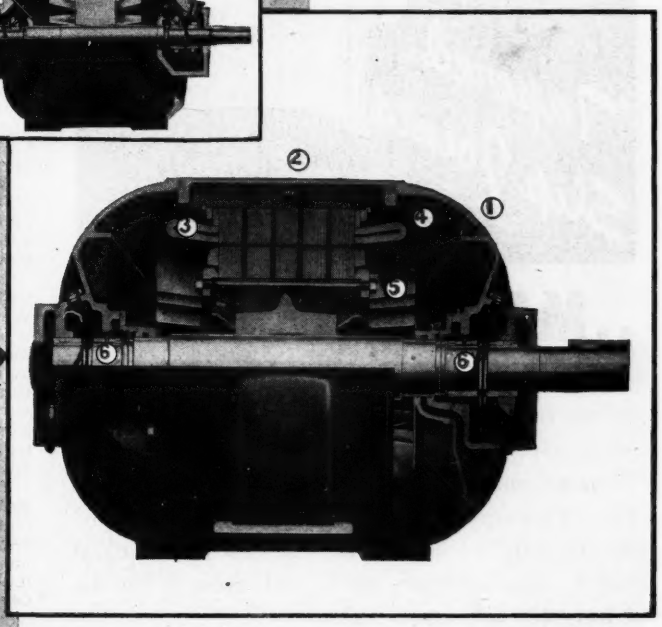

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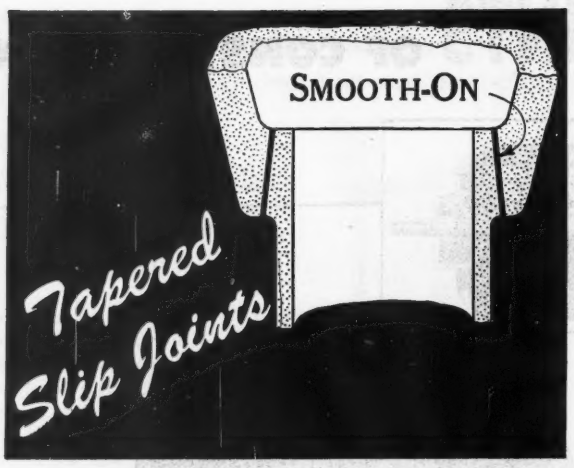

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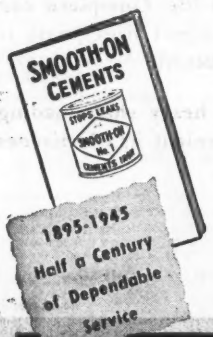

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consisting of a main one-story building, 138x215 ft, and smaller structures. An air-conditioning system will be installed. Cost reported close to $1,000,000, with machinery. Work will begin in near future. Lockwood, Greene Engineers, Inc., 40 Central Ave., Boston, Mass., is consulting engineer.

Minn., Rochester—Electric Light Dept., 310 North Broadway, has plans in progress for new municipal power plant in Silver Lake area, to supplement present city-owned station. Installation will include a 7500-kw turbine-generator, boiler unit and auxiliary equipment. Estimates of cost are being made. Sargent & Lundy, 140 South Dearborn St., Chicago, Ill., are consulting engineers.

Minn., Wilmar—Water and Light Dept., has plans under way for improvements in municipal steam-electric generating station, including installation of new coal and ash-handling equipment and other facilities, with power station piping. Pfeifer & Shultz, Wesley Temple Bldg., Minneapolis, Minn., are consulting engineers.

Mich., Saginaw—Chevrolet Motor Division, General Motors Corp., has plans for new power house at local branch works, forming part of expansion program at plant, which will include foundry and pattern shop. Electric power equipment will be installed in latter structure. Entire program reported to cost in excess of $450,000. Work will be carried out at early date. Main offices are at 3044 West Grand Blvd., Detroit, Mich.

N. C., Burlington—Celanese Corp. of America, Inc., 180 Madison Ave., New York, N. Y., plans new boiler house in connection with expansion in branch rayon mill at Burlington. Work will include new two and one-half story addition to spinning and carding mill, and extensions in other departments. Electric power equipment will be installed. Entire project will cost about $700,000. Work scheduled to begin soon.

Tenn., Morristown—Belding Heminway Co., 119 West 40th St., New York, N. Y., spool silks, cotton thread, etc., plans installation of electric power equipment in proposed new branch mill at Morristown, where large tract of land has been selected. It will comprise several large one and multistory buildings. A boiler house is planned. Entire development will cost over $1,000,000. Proposed to begin work at early date.

Texas, El Paso—El Paso Electric Co., has plans for addition to steam-electric generating station for extensions in steam division, including installation of new high-pressure boiler and auxiliary equipment. Work is scheduled to begin soon. Stone & Webster Engineering Corp., 49 Federal St., Boston, Mass., is consulting engineer. Program reported to cost over $500,000.

Va., Jarrett—Johns-Manville Corp., 22 East 40th St., New York, N. Y., has authorized expansion at insulating board mill at Jarrett, comprising several new buildings, totaling 75,000 sq ft floor space. Electric power equipment will be installed. Cost estimated about $1,000,000. Work will begin soon.

W. Va., Nitro—American Viscose Corp., Delaware Trust Bldg., Wilmington, Del., has approved plans for expansion in rayon and staple fiber mill at Nitro, comprising several new buildings with machinery installation for considerable increased output. Electric power equipment will be installed. Power plant facilities at mill will be increased. Entire project is reported to cost close to $1,200,000. Work will be placed under way soon.

Wis., Black River Falls—Municipal Electric and Water Dept., has plans in progress for new addition to municipal hydroelectric generating station, 31 x 74 ft, with installation of equipment for increased capacity. Proposed to carry out work next spring. Estimates of cost are being made. Mead, Ward & Hunt, 550 State St., Madison, Wis., are consulting engineers.

Wis., Milwaukee—A. George Schulz Co., 433 West Clybourn St., paper boxes and containers, plans installation of electric power equipment in proposed new plant at North 20th and West Congress Sts., where large tract of land has been acquired. It will comprise a main one-story building and several auxiliary structures. A boiler house and power substation are planned. Entire project reported to cost close to $2,000,000. Austin Co., 510 North Dearborn St., Chicago, Ill., is engineer.

Wyo., Sheridan—Bureau of Reclamation, Denver, Colo., has preliminary plans under way for proposed hydroelectric power plant near outlet of Shoshone Canyon conduit, about 3 miles south from Shoshone Dam, to be known as Heart Mountain power development. Station will be equipped for initial capacity of 5000-kw, and is reported to cost about $900,000. It is understood that appropriation has been arranged.

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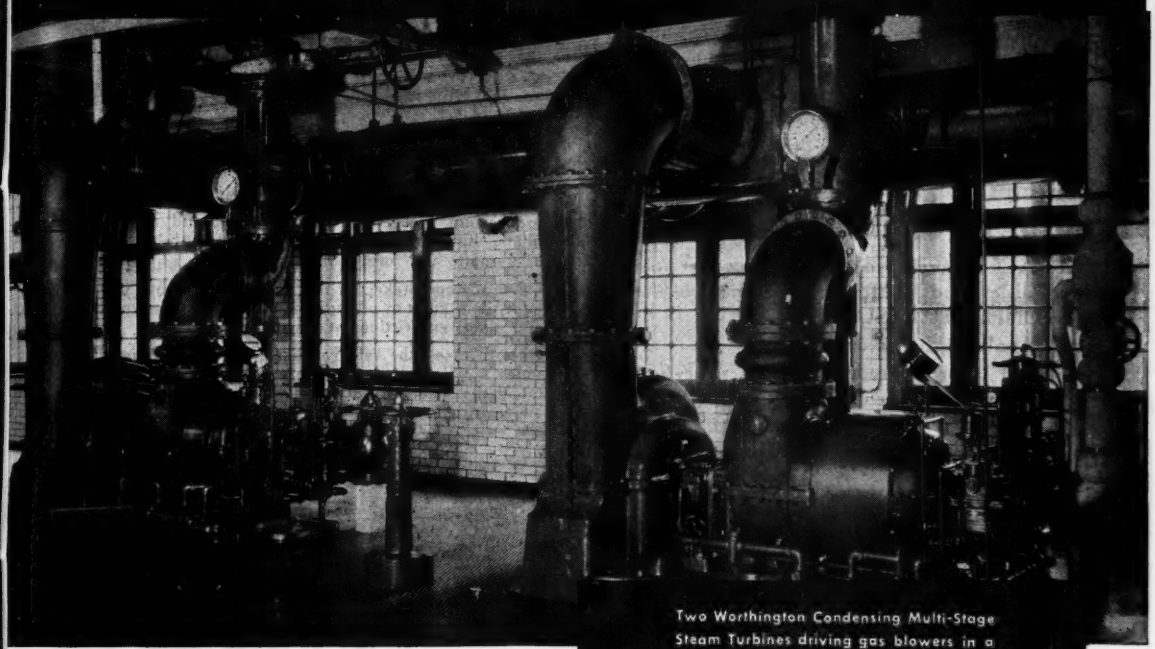

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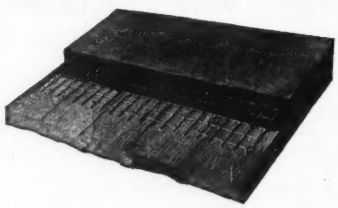

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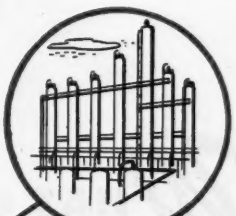

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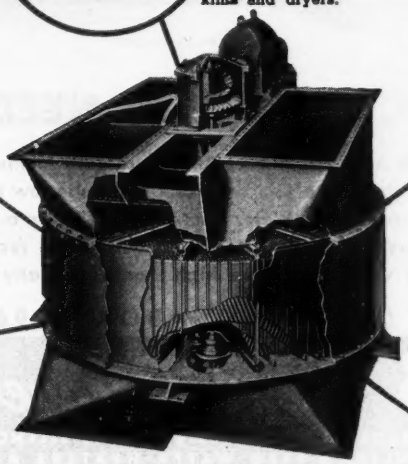

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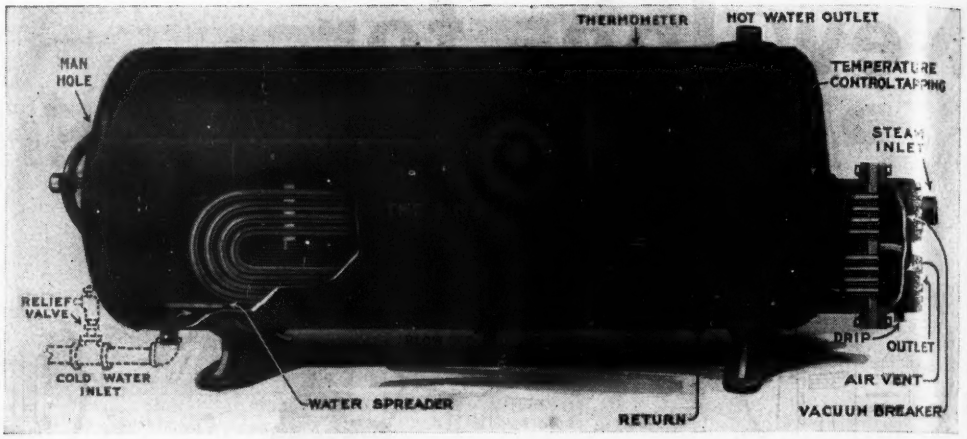

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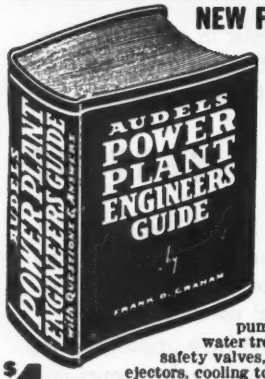

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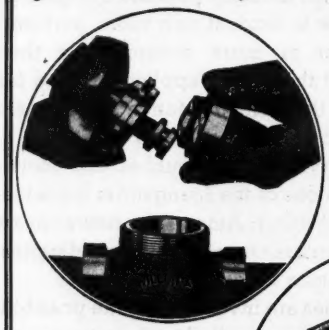

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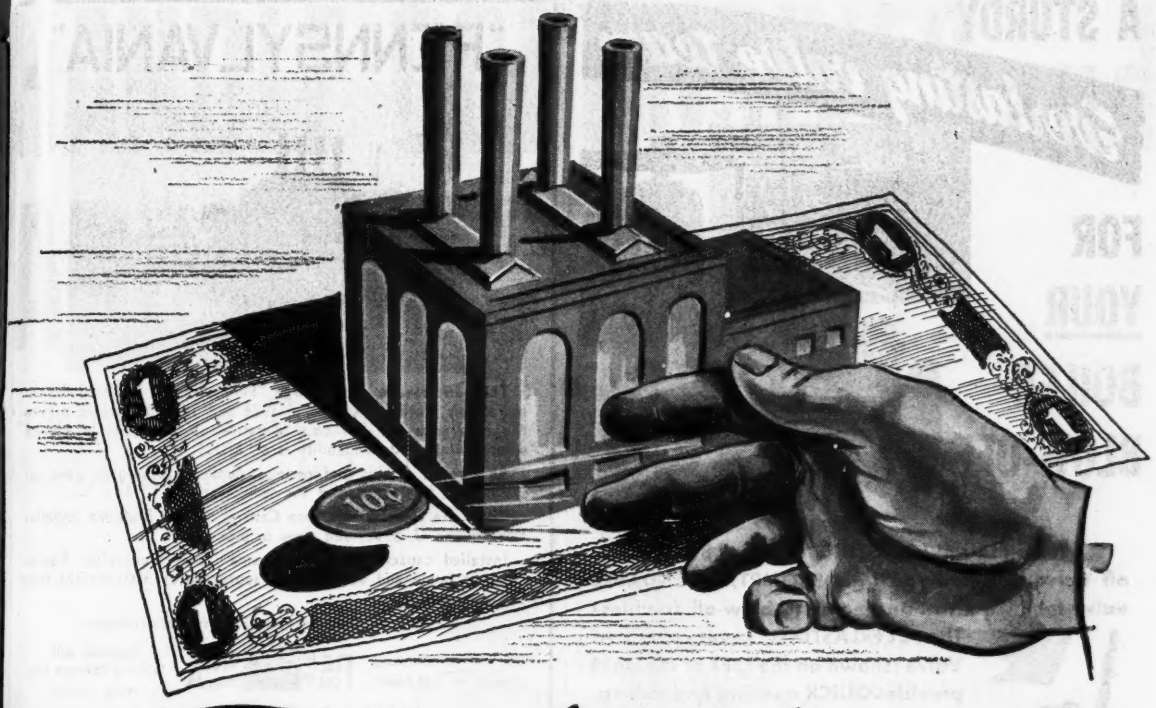

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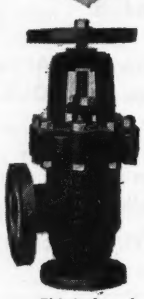

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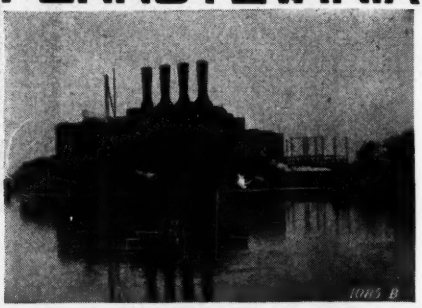

The performance of two large "Pennsylvania" Bradford Breakers at this Station, installed in 1923 and 1926, has again proven the endurance and low cost operation of this type, in service *where unfailing dependability is a "MUST."*

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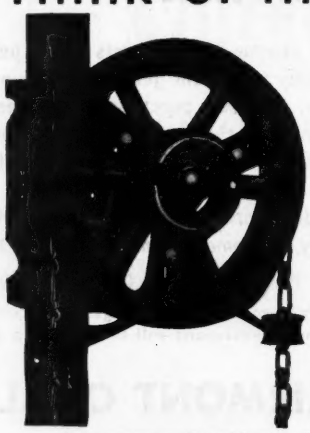

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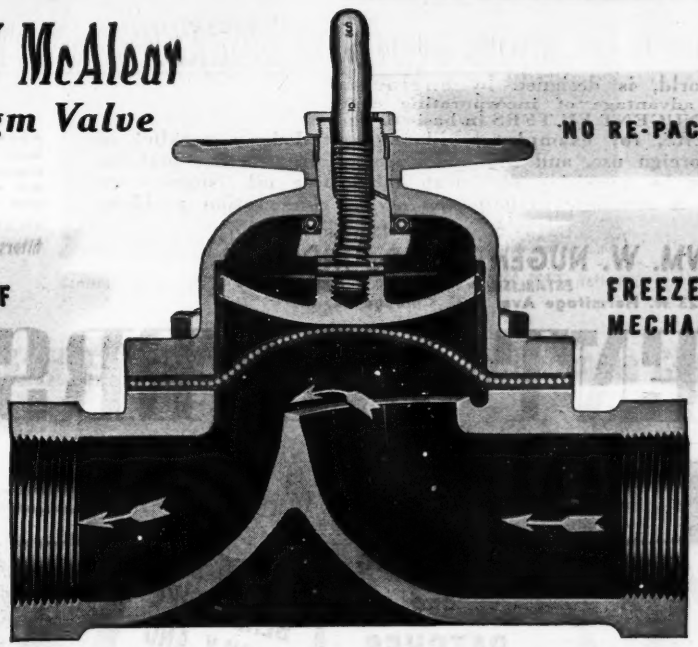

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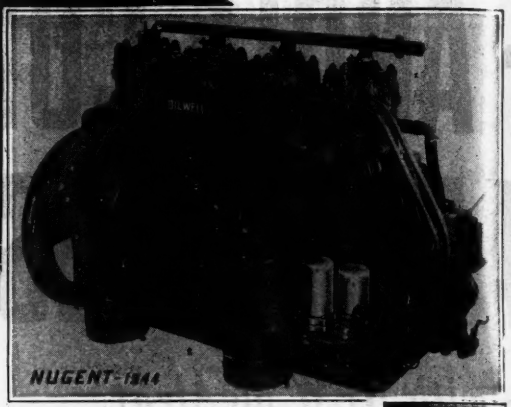

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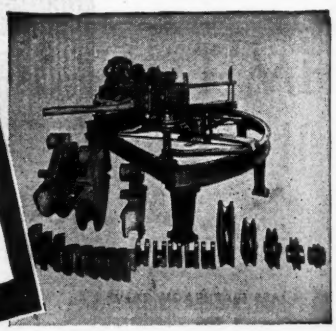

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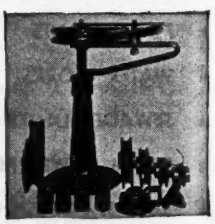

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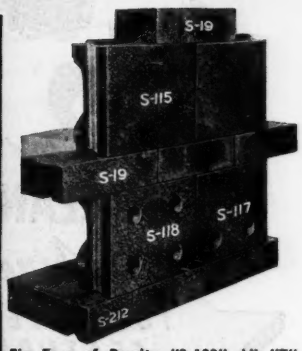
How to Cut Down on Your Furnace Maintenance

Rear View of Bernitz "S-100" All "T" Super Block Construction

Central Station Furnace After 18 Months' Hard Service at 300-350% Rating



Fire-Face of Bernitz "S-100" All "T" Block Construction

Air Cooled BERNITZ SUPER BLOCKS End Bothersome Clinker Adhesion

ABOVE you see an example of how BERNITZ SUPER BLOCKS keep clinker from sticking to side walls. How do they do it?

By taking advantage of the properties of silicon carbide, from which they are made. Silicon carbide naturally resists clinker adhesion, and it has very high heat conductivity. It also has great mechanical strength.

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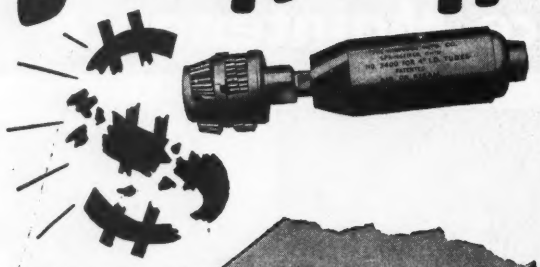
SMASH



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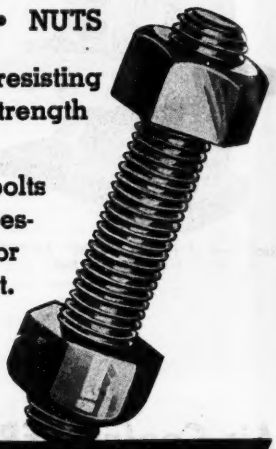

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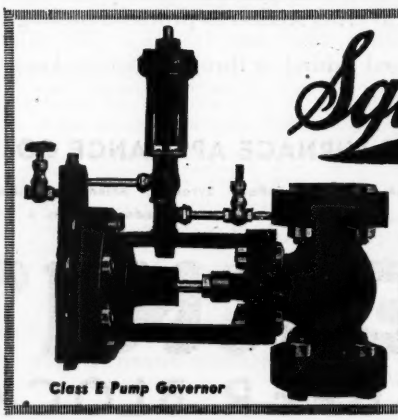

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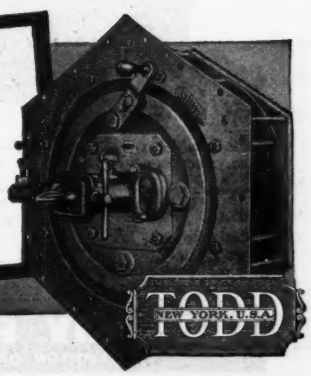

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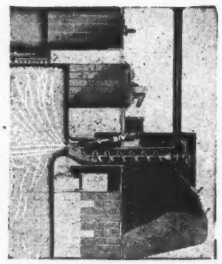

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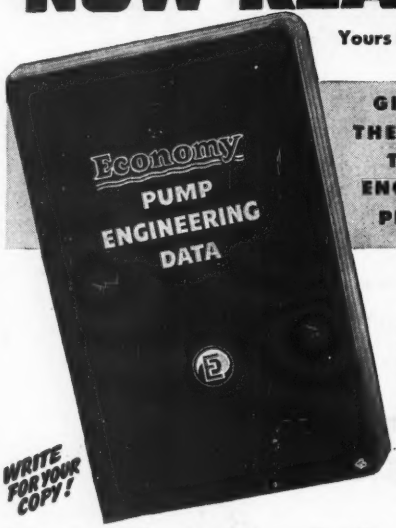

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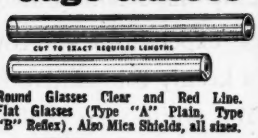

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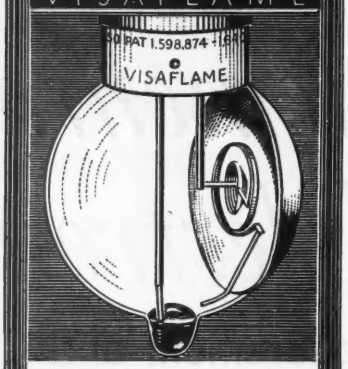

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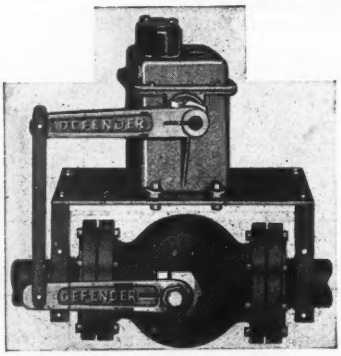

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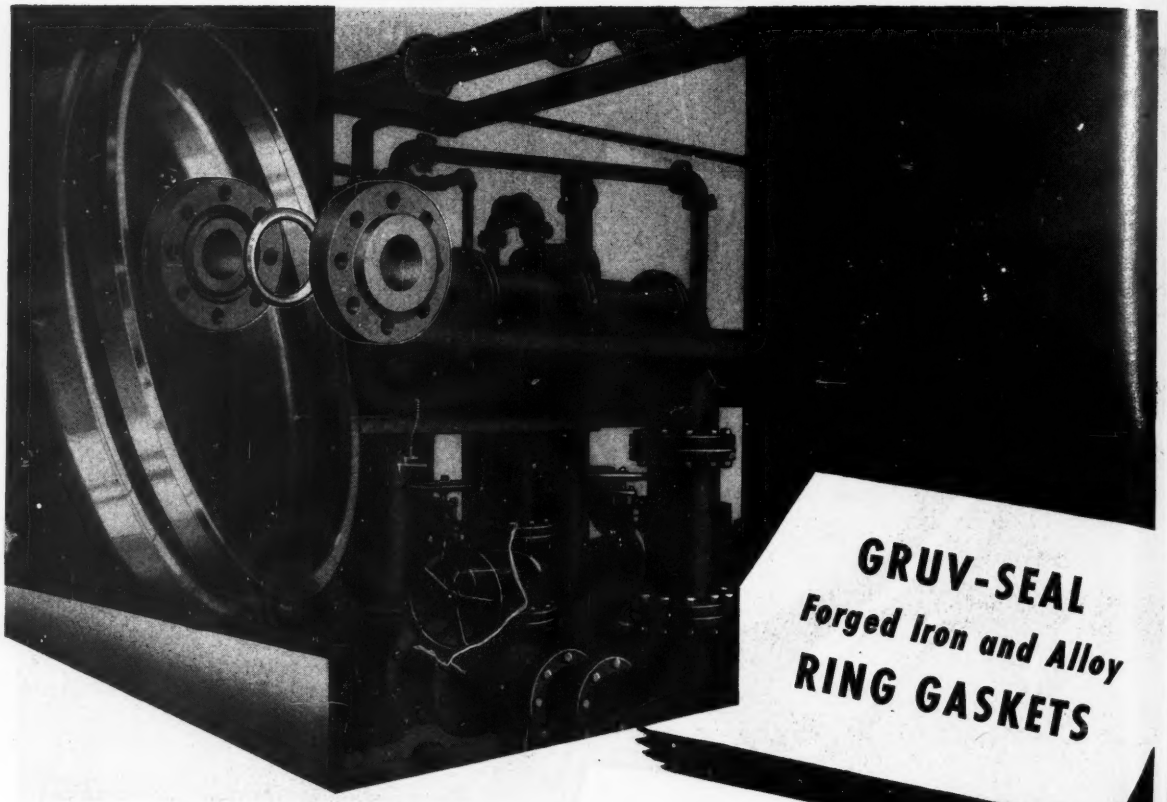

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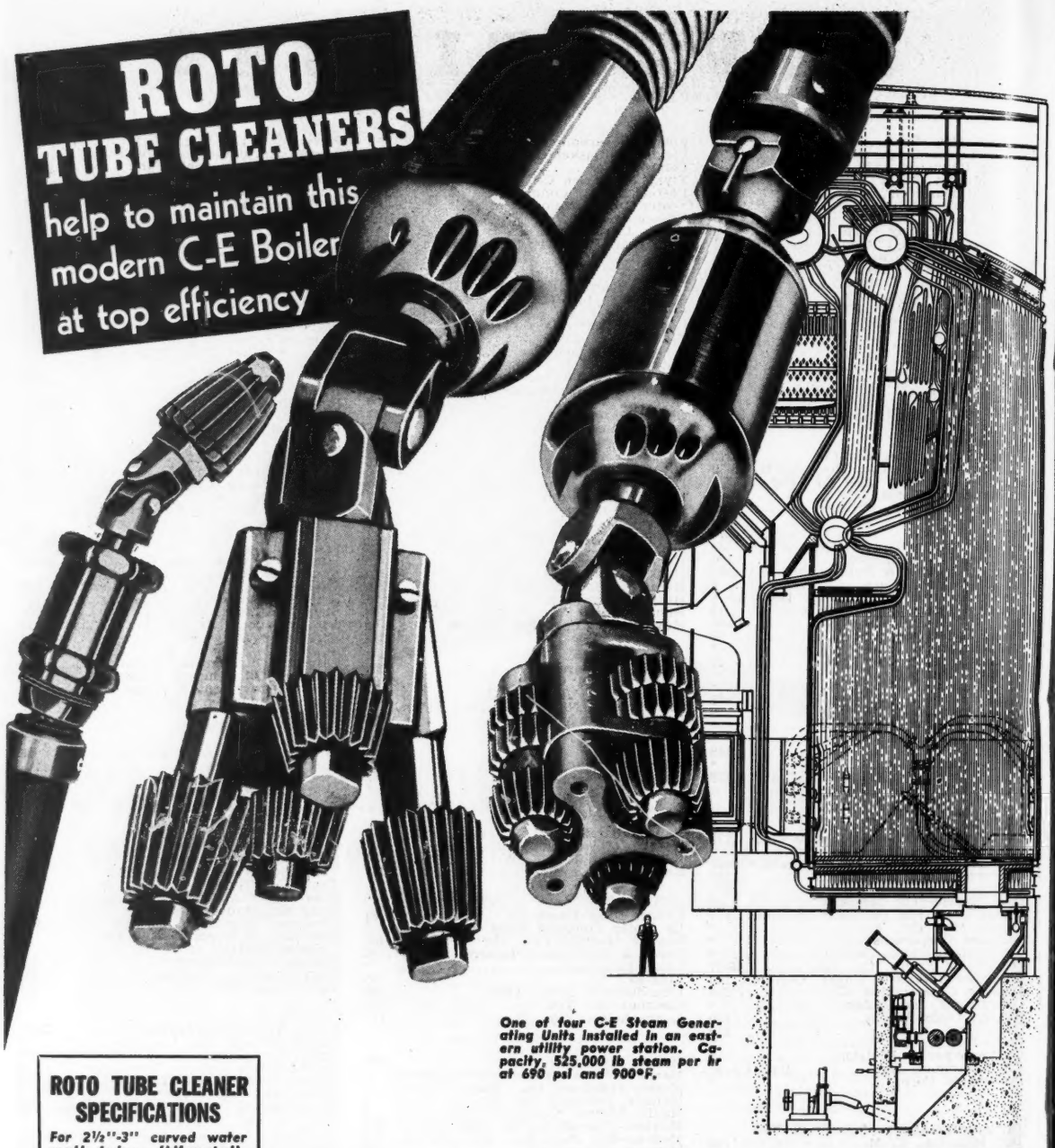

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Electrically operated valves save time, trouble, and accidents

Opening and closing valves can be a slow, difficult, and hazardous task. Or it can be done quickly, easily, and safely with Cutler-Hammer Valve Control by merely pushing a button. And thousands of installations prove that a small electric motor with Cutler-Hammer automatic control can do a better, surer job of operating any valve than the huskiest or most experienced man can do by hand. Even on high pressure, high temperature steam lines, where valves are often so hot they glow red, the Cutler-Hammer controlled-thrust-seating mechanism closes valves without any danger of jamming.

Distance means nothing to Cutler-Hammer Valve Control. The operation of any valve or any number of valves, whether located in the next room, on the next floor, or miles away, is immediate, certain, and effortless. Many water and gas supply networks, as well as far-flung gas, gasoline, and oil pipelines, effect centralized control of their facilities with this system. The "Little Inch" pipeline from Texas to New Jersey, for instance, uses 212 Cutler-Hammer Valve Control units. Also, as is obvious, the electrical operation of valves makes possible the *automatic* control of processes. This is widely utilized in the chemical and petroleum industries. In fact, it has been said that today's high octane refining would not have been possible without electric valve control . . . where hundreds of Cutler-Hammer Valve Control units are employed, often in interlocked sequence for the utmost precision of process control.

Cutler-Hammer Valve Control can be applied to valves now in service, or can be built into any make of new valves being purchased. The many opportunities it offers for the improvement of processes, for greater efficiency, and for the utmost protection to men and equipment recommend it for most serious and thorough investigation *today*. The broad experience of the nation-wide staff of Cutler-Hammer engineers is available for the study of *your* specific problems. **CUTLER-HAMMER, Inc., 1392 St. Paul Ave., Milwaukee 1, Wisconsin.** *Associate:* **Canadian Cutler-Hammer, Ltd., Toronto.**

Engineering excellence finds its greatest reward in the respect and confidence of those it serves

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MOTOR CONTROL
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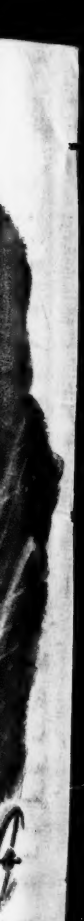

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